ETHNOBIOLOGICAL KNOWLEDGE OF THE SONORAN DESERT: IDENTIFYING INTER-GENERATIONAL LEARNING AND VARIATION

by

COLLEEN MARIE O'BRIEN

(Under the Direction of Brent Berlin)

ABSTRACT

Recent ethnobiological research has demonstrated generational differences in nature knowledge and methods of learning and a loss of ecological knowledge in younger generations. This dissertation investigates ethnobiological knowledge distribution among children and adults in Ajo, Arizona, a rural town located 30 miles north of the United States / Mexico Border in the Sonoran Desert. Ethnographic research using a mixed method approach of quantitative and qualitative data collection and analysis was conducted over 18 months to determine if behavioral or demographic factors contribute to knowledge variation both within and between two generational cohorts. Structured interviews included 129 Anglo, Mexican, and Tohono O'odham participants. Interviews consisted of a free listing exercise, recognition test of 45 culturally salient plants and animals elicited through video clips, and structured questions on demographics, learning, and behavior. Both cohorts report learning ethnobiolgical knowledge primarily through vertical transmission from parents and grandparents. Children are more likely than adults to be limited to declarative (naming abilities) rather than procedural knowledge (uses and beliefs) about Sonoran plants and animals. Today, children are learning in different ways than adults did at their age, which does not necessarily affect the quantity of what they know, but rather the quality and content of their knowledge. Children are limited to

generic names while adults use species specific names. Changes in acquisition and exposure have prevented the persistence of knowledge about certain key species such plants used for wild foods in younger generations. Recognition scores increase significantly with age, location of home, park visitation, and hunting in the children's cohort and ethnicity in the adult cohort. Naming and recognition abilities are not significantly associated with how the knowledge was acquired. However, children who participate in experience-based activities such as hunting are better able to identify wild foods, know more species-specific names, and have more knowledge about ecology and uses. These findings suggest that situated learning that occurs within an ecological and social context imparts knowledge that is qualitatively different than abstract learning. Results are being applied to biocultural educational program development in nearby Organ Pipe Cactus National Monument.

INDEX WORDS: Cognition; Cultural Transmission; Ethnobiology; Ethnobotany; Ethnoecology; Biocultural Education, Traditional ecological knowledge; Situated Learning; Indigenous Education Models; Sonoran Desert, Arizona.

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DEDICATION

To my parents for all of their support over the years, to my brother Bill for providing advice, humor, and inspiration, and to Sydney for years of companionship during all of my travels.

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Introduction

Figure 1.1 Artist Michael Chiago's painted mural of two O'odham women carrying *bahidag*, cactus fruit and *ku:ipad,* harvesting sticks made from the ribs of dead saguaro cactus. Harvesting of cactus fruit occurs in July just before the arrival of the monsoon rains.

Children's loss of environmental knowledge[1] is an increasingly talked about subject in ethnoecology as well as in the press and popular literature. Researchers studying the devolution of environmental knowledge have noted that younger generations are increasingly more removed from the natural environment positing that this loss of contact may prevent an innate curiosity for the natural world from ever developing. Hunn (2002) and Nabhan and Trimble (1994) have both proposed that environmental

[1] The term knowledge is used throughout this manuscript referring specifically to expertise and skills acquired through various means of transmission. Because this dissertation is inclusive of both plant and animal knowledge I use the term ethnobiological knowledge when describing my focus. However, knowledge is also used in conjunction with cultural, environmental, ecological, or traditional in this text when speaking in more general terms or when referring to previous research in these domains.

knowledge is also lost when children today have less intimate contact and experiences with the natural world. Some of the locations where researchers have investigated the loss of knowledge in younger generations are in Mexico (Ross 2002), Canada (Ohmagari and Berkes 1997), Venezuela (Zent 2001) and the United States (Nabhan and St. Antoine 1993). One common focus has been an attempt to identify some of the factors leading to a loss of environmental knowledge in younger generations.

Anthropologists have long been interested in documenting the cultural knowledge systems that result from the complex relationships between humans and the environment. Such knowledge systems helped humans survive in a drastic climate like the Sonoran Desert for thousands of years. Over this time period, cultures accumulated an extensive knowledge of animals, medicinal plants, wild foods, and weather patterns that was vital to survival in the desert. For example, Figure 1.1 depicts O'odham women participating in *ha:san ba:k masad*, and annual cactus fruit harvest festival marking the arrival of monsoon rains, essential to life in the desert.

The ways that people acquire knowledge about the natural environment have changed over the past several generations. In the past, people's primary means of transmitting ecological knowledge was through songs and stories, passed on from generation to generation. Today, a greater number of children acquire ecological knowledge in formal classroom settings, or rely on television, books, or videos for instruction, activities that are not socially interactive and are separated from the natural environment (Kimmerer 2002, Nabhan and Trimble 1994). Research conducted over a decade ago in Arizona revealed a profound loss of plant and animal knowledge including names, uses, and ecological information when comparing children to their parents and

grandparents (Nabhan and St.Antoine 1993). Television, books, and the internet have largely replaced experience-based and situated[2] learning, referred to as an "extinction of experience" in child development literature (Kahn and Kellert 2002, Louv 2005, Pyle 1993).

When this shift in knowledge acquisition and learning occurs not only is the *quantity* of what is known affected, but the *quality* changes as well. For instance, a person may be vaguely familiar with the name of a plant. They may be able to name and talk about the plant. They may even be able to recognize a photo or specimen of that plant. But, they would not know how to cultivate it or how to prepare or use the plant for medicine. Thus, the central focus of this research is to discover whether a shift in knowledge acquisition is occurring and if so, how this shift is changing both the quantity and quality of what is known about nature, specifically the domain of plants and animals.

Research Questions and Approach

The overall research question of this dissertation is: Does ethnobiological knowledge vary based on learning contexts? In order to answer this question, it is necessary to identify differences regarding not only *what* is known but *how* knowledge is acquired, both within and between generations. Associated questions were derived based on literature regarding the acquisition, transmission, transformation and loss of ecological knowledge. For example, what do people know about plants and animals and how does

[2] Situated knowledge refers to knowledge that is specific to a particular situation. Situated knowledge is usually gained through experience within an ecological or social context and is embedded within culture. It is a term derived from educational literature on knowledge and learning. See Lave and Wenger's 1991 foundational book Situated Learning: Legitimate Peripheral Participation for theoretical background and applications.

this vary both within and between generations? Are there certain characteristics of people who know more about plants and animals than others? Or, are there certain characteristics of the plants and animals themselves that make them more recognizable or memorable? Secondly, what methods of learning are reported by children and adults? Do adults report learning in more experiential, social, and situated ways (as children) than the present generation? If so, does this change what they know? Finally, what accounts for these changes in learning? Are reasons of acculturation or a divergence from a more traditional lifestyle explanation enough? Or are there other factors like lack of interest or lack of opportunities for nature exposure that come into play? Are there still traditional activities practiced by some people that contribute to persistence of knowledge?

Returning back to the central question of this research, "Does ethnobiological knowledge change based on learning contexts?", in order to operationalize knowledge, it was necessary to differentiate between a quantity of knowledge and the actual quality and content of knowledge. Thus, there are fundamental differences in what accounts for knowledge about a particular plant or animal. Does knowledge refer to the ability to name or identify a referent? What about cultural or traditional knowledge of skills and uses such as how to prepare a plant for medicine or where and when to hunt a particular animal? Acknowledging that there are qualitative differences in plant and animal knowledge, one possible research finding is that adults will know a different type of information than children. Previous research indicates that children are more likely to know generic names for plants and animals than adults, who have retained specific names (Berlin 1992, Zarger 2002,). Also, adults know more culturally based knowledge about referents such as how to prepare a plant to eat since they have had the experience of

doing so. However, it would be injudicious to assume that age is the only factor accounting for how much or what type of information a person knows since this research demonstrates that there are many individuals within the children's cohort who also know species specific and cultural information. So, there appear to be additional factors besides age that influence some individuals to know different types of information than others.

This dissertation applies an ethnographic approach to the overall question of whether knowledge about plants and animals changes based on learning contexts by documenting what is known and how information is learned and transmitted among two cohorts representing multiple generations of Anglo, Mexican, and O'odham in the community of Ajo, Arizona, located in the heart of the Sonoran Desert. In order to address the central research question, a mixed method approach was chosen using quantitative and qualitative data collection and analysis. The data analysis will focus on intra and inter-generational differences in plant and animal knowledge, specifically identifying the ecological and social contexts in which learning takes place, and differentiating the type of knowledge that individuals possess. In doing so, this dissertation will attempt to determine some of the contributing factors to variations in knowledge between older and younger generations by describing social, cultural, economic, and environmental changes that have taken place in the region over the past several generations that may affect both teaching and learning.

The research framework encompasses a synthetic mix of theory in ethnoecology and ethnobiology, cultural transmission, and situated learning. This dissertation draws on socio-cultural and cognitive theory and methods in order to describe and explain learning in social, cultural, and ecological context. A shift in ethnoecological studies from

descriptive to more explanatory models provides an array of recent methodology on determining knowledge variation and change in younger generations employed in this study. This dissertation will add to the literature in this area and provide comparative data with which to continue research on processual studies in ethnobiology.

Propositions and Expectations

Overall, it was expected that there would be a large difference between what children and adults know about plants and animals. Accordingly, the following propositions were derived from research on ethnobiological knowledge studies. First, it was expected that adults would be able to name a greater number of plants and animals than children. Their lists would contain more local or native items as well as more species specific names for plants and animals. It was also expected that children's naming abilities would be limited to generic as opposed to specific names for plants and animals. Children were also expected to name more non-native rather than local or native plants and animals than adults.

The second set of expected propositions involve characteristics of plants and animals that would be named and recognized. According to preliminary research conducted at the field site, it was expected that culturally salient and recognized animals for both children and adult lists can be characterized as "dangerous" i.e. creatures that bite or sting (O'Brien 2005). It was expected that there would also be specific plants and animals that are no longer recognized by the younger generation, but are still recognized by adults.

The next set of propositions involve the ability to recognize a plant or animal. It was expected that adults would recognize and correctly identify a greater number of plant and animal referents than children in the study. Furthermore, it was proposed that recognition scores would vary within each cohort according to demographic characteristics such as age, gender, ethnicity, years of residence, contact with grandparents, and languages spoken, and by behavioral characteristics such as methods of learning and free time activities.

Children and adults were expected to report different learning methods and experiences. According to previous research conducted by myself and other researchers in the region, mass media and school will be the most frequently named sources by children (Nabhan and St. Antoine 1993, O'Brien 2005). On the other hand, it was expected that adults would report having learned as children most often through social interactions and situated learning experiences with parents, grandparents, and siblings. Prior research indicates that people who first learn about a plant or animal through a situated learning experience have a greater amount of cultural knowledge about its uses, beliefs, practices, and inter-specific interactions, referred to in the literature and herein as traditional ecological knowledge or TEK [3] The theory is that cultural knowledge will be distributed according to the context in which learning first took place (i.e. abstract learning such as media, versus social contexts such as learning from a grandparent) (see Atran 2001, Ross 2002, Zent 2001). Therefore, adults, assumed to have more experiential

[3] TEK also refers to traditional environmental knowledge, and is sometimes used synonymously with local knowledge and indigenous knowledge. For the purpose of this study, knowledge is ecological in that it refers to the plant and animal names, uses, beliefs, practices, and inter-specific interactions of culturally significant species. Furthermore, culturally-based ecological knowledge is defined as *traditional* not because it is static, archaic, or homogeneous, but because traditional refers to the way in which it is usually learned and acquired, which is typically orally and between generations.

learning, would demonstrate a different quality and content of knowledge than children, with the ability to specifically name, recognize, and talk about cultural uses and beliefs about referents. TEK would therefore be expressed by participants during interview narratives and open ended discussion.

Novice Versus Expert in the Study of Ecological Knowledge

Over the past two decades, ethnobiological research has focused on identifying variation within and between cultural groups. Intra-cultural variation exists because individuals vary in their abilities, access to knowledge, and motivations for learning (Boster and Johnson 1989). So, as Boster and Johnson note *who* we ask may be just as important as what or how we ask when it comes to cultural knowledge and classifications about natural kinds.

Differences exist in the way that novices and experts not only classify natural kinds but in how they understand and relay information, and in their ability to have access to such information. Research carried out by Boster and Johnson (1989) tested these claims by determining whether differences exist between experts and novices in the way that they classify natural kinds. Results indicate that experts and novices differ by both the amount and type of knowledge and by their access to knowledge. Because experts are exposed to experiential based cultural beliefs in addition to morphology they tend to use what knowledge they have access to in basing their judgments. Because novices have no access to this cultural knowledge, they adhere to morphological or intellectual models.

With the focus of the research questions presented in this dissertation related more to the diachronic properties of knowledge, how it is changed, transformed, and learned

across generations, rather than on cognitive differences between experts and novices, it was not appropriate to limit this study to expert participants. Therefore, both experts and novices are included as research participants.

It is important to note the fundamental differences in interviewing expert versus novice individuals on ethnobiological topics. Novices, lacking the breadth and depth of expert knowledge, have less patience for participating in lengthy elicitation tests. In addition, because certain types of knowledge such as TEK is assumed to be limited among novices, it was necessary to make decisions on what to include in the knowledge test based on this assumption. This is addressed below in the section Limitations of this Study.

Expert informants were consulted during the first stage of the research in order to identify the most culturally salient plants and animals to include in the interviews, and to obtain a general idea of the content of the cultural domains of plants and animals of the Sonoran Desert. Some of the grandparents and parents of student participants interviewed later in the study turned out to be experts, however they were not sought out for their expertise, but rather this was a circumstantial occurrence.

Study Limitations

In order to focus this study and collect a reasonable amount of data, interviews were limited to a subset of 20 plant and 25 animal referents, identified as the most salient using expert interviews and ethnographic content analysis of previous ethnobiological and ecological research in the region. Due to a loss of detailed knowledge about plants and animals in this region as determined by previous research (Nabhan and St. Antoine

1993; O'Brien 2005) it was expected that the majority of children would not know TEK about Sonoran plants and animals. Therefore, structured interviews focused on testing naming and recognition abilities rather than on evaluating their knowledge of ecological information or cultural uses and beliefs. Traditional knowledge was however solicited during open ended questions about the plant and animal referents and collected in the form of narratives. The purpose of this is not to quantify TEK for each referent as the study was not designed with the structure to do so, but rather to add context and derive examples in order to explain knowledge variation and distribution indicated by the quantitative data.

The next limitation involves methodology for collecting data on learning. Rather than following a chain of who knows what to trace knowledge through social networks of family members, a recall method was used to determine who teaches people about plants and animals. One problem with the recall method is that people normally identify a family member, namely a parent as their primary teacher (Bernard, 2002, Reyes et al. 2007). Siblings and peers often go unreported with the emphasis being instead, on vertical transmission. One way that this issue was addressed was to try to interview children's family members as the adult cohort in order to corroborate on the younger cohort's answers. Thus, in some cases, parent and grandparent narratives supported children's accounts of vertical transmission.

Notes on U.S. Based Fieldwork

I thought it important to acknowledge upfront some of the differences

and challenges of conducting fieldwork within one's native country. Upon deciding to conduct my research in southwestern Arizona, some of the comments that I received from colleagues and friends were along the lines of, 'Wow, you're lucky to be doing research here in the United States. It'll be so much easier'. Indeed, from an administrative and cost point of view, they were right. In comparison to some of my colleagues, my $300 roundtrip airfare ticket from Atlanta to Phoenix was far more reasonable than some of their tickets, which ran into the thousands. This afforded me the ability to be able to travel from my site to conferences, back to the university to handle administrative details, and allowed for a follow up trip in the Spring of 2008 to reconnect with study participants and to present my results at a community forum. Without the hassle of foreign communication systems, I was also able to complete the bureaucracy of grant management paperwork while at my field site.

However, as with everything, benefits are usually accompanied by some unforeseen drawbacks. For one, gaining access to a rural United States community proved harder than one would think. Having completed Master's level research in Costa Rica, I had experienced the novelty of being the foreign stranger, and had indeed used people's general interest in the exotic to my advantage in terms of gaining access to communities and to persuade people to talk to me. However, being a foreigner in ones own land is not novel, as one of my native Ajo research associates put it "it's just plain weird". The blanket of trust that seems to come with Americans abroad does not apply to foreigners in the rural United States. Simply put, I was not trusted. Furthermore, a female living and studying by herself was peculiar and far from typical. That said, access to this community took me longer than I had thought and prolonged my research by six months

since I did not begin my interviews until I felt that I was more accepted and people were more comfortable with my presence. However, during this time, I did learn some strategies that helped me not only become more trusted but gain access to people in the community. These are discussed further in Chapter Three and are interspersed throughout this dissertation.

Outline of This Work

I have organized my presentation into the following framework. Chapter Two will present an ethnographic overview of the study area and residents including ecological and cultural background on the Sonoran Desert. I will describe the cultural groups that have lived in the region and passed down knowledge of how to live in the desert environment and some of the social and environmental challenges in the region. I will end with an ethnographic overview of Ajo, Arizona, including demographic information on the community. In Chapter Three, I provide theoretical background and situate my own study within the framework of focusing on the processual aspects of ethnobiological knowledge. I will detail my research questions and expectations, explain my research design and methods, and describe how the study was conducted including methods for choosing participants, the creation of data collection tools, and the administration of interviews and other data collection activities. In Chapter Four, I begin the presentation of my findings. I start with what the participants in both the children's and adult cohorts know about plants and animals. Free lists and recognition test scores are reported. I will address the subject of knowledge variation by identifying plants and animals that are not named and recognized in younger generations. I will highlight differences in knowledge

between generations and within the same generation and present those differences based on language, age, gender, learning activities, and hobbies. In Chapter Five, I will look at the question of how people learn about the desert by presenting what was reported during interviews. Through excerpts from transcribed interviews, I will provide examples of social activities such as hunting and camping trips which are primary sources for cultural knowledge acquisition and transfer. I will also provide ethnographic detail from my own observations of community practices. I will look at some of the social and cultural changes that have taken place over the generations that may explain why certain knowledge is lost, while other knowledge persists. Finally, I will discuss some of the factors concerning knowledge variation including such topics as motivational change, parental and adult attitudes, how desert animals and plant's relevance to everyday life has changed, and opportunities for learning and exposure to nature. Chapter Six will summarize these research findings and address whether the propositions set forth in this introductory chapter were supported by the data. I will discuss the significance of this research to anthropological theory and describe ways in which the research has been beneficial to the community of Ajo, including how the results are being applied in local conservation and educational efforts at Organ Pipe Cactus National Monument.

Notes on Presentation of Data and Style

I use the true names for all geographical locations and people unless otherwise noted. I use pseudonyms or generalities for children participants in order to protect confidentiality. I use the common plant or animal name in English when referring to plant or animal referents. Scientific, Spanish, and Tohono O'odham names are provided in the

tables in Appendix A. The tables are presented alphabetically by common names unless otherwise noted. Spanish or O'odham words appearing in the text are written in italics. I use the local term "Mexican" to refer to both Spanish speaking national residing in Mexico as well as people of Mexican birth or ancestry living in the United States. I use the local term "Anglo" when referring to whites of any ethnic background.

I indicate a paraphrased conversation using single quotation marks. Direct quotations are indicated by double quotations marks. When direct quotes are more than one line in length they are indented, single-spaced, and typed in italics. Unless otherwise noted, direct quotes are labeled using the interview questionnaire code which contains the first letter of the interviewer's first name and a numeric value (e.g. C10). Direct excerpts from my field notes are provided for ethnographic detail, to illustrate key points, and to share my reactions. Field note excerpts are presented in italics and indented in the text.

Chapter 2

The Sonoran Desert in Ecological and Cultural Context

"What draws us into the desert is the search for something intimate in the remote"
Edward Abbey

Figure 2.1 A flooded *arroyo* along the Ajo loop road in early August shortly after the arrival of the monsoon rains. The desert takes on new life after the rains, transforming practically overnight from a dusty brown to a lush green landscape. During my walk this morning, I found tadpoles in the water, life that had emerged from the desert floor in a mere few days time.

If you ask someone where the Sonoran Desert begins and where it ends they will usually tell you that the desert is more of a feeling than an actual geographical boundary. They will tell you, 'When you're in the Sonoran Desert, there are certain smells and sounds that are unlike anyplace else in the world'. And if you ask them to describe the

smell of the desert, they will tell you without hesitation, ‘the desert smells like rain’. Of course, if you refer to a textbook or a map of the region, you’ll find that the Sonoran Desert is comprised of two countries and five states, spanning 100,000 square miles (Dimmitt 2000).

Figure 2.2 Map depicting the geographical expanse of the Sonoran Desert.

I made my first visit to Ajo, Arizona during the summer of 2004. I had traveled to Tucson to visit friends on several occasions since 1999 and was familiar with the urban desert of Tucson and the surrounding area. I had not however, traveled into the far more expansive land to the west of Tucson. The following excerpt illustrates my thoughts while traveling west across the Tohono O’odham reservation.

Excerpt from field notes January 3, 2006:

As I drove across Highway 86, the winding two lane road that transects the Tohono O'odham Reservation on the way to Ajo, I was struck by the starkness of the scenery. I had left early on a Monday morning, hoping to beat the rush hour traffic leaving Tucson, and the sky was a lavender gray, layered along the horizon and slowly fading into the outline of a mountain ridge far off to the west of the road. I could see the sun rising behind me, setting the desert vegetation aglow with an eerie color of green. I remember thinking how much the desert landscape, with its playas or flat sand plains resting between rocky sloping ridges resembled an underwater landscape—with the low growing scrub like plants and shrubby trees mimicking underwater coral gently swaying in the waves or in this case, the wind. With my window rolled down traveling along the empty road toward Sells this morning, I can smell the greasewood on the air, spicy and sharp. It is the greasewood or 'rain tree' as it is called that releases its oily resin into the air shortly before the rain filling the desert with its unique incense like fragrance that to locals reminds them of the rain. Out of the corner of my eye I see the outline of a turkey vulture circling overhead. I feel the quiet and calm of the open desert and for that moment, I can imagine what brought people to stay in this place.

At 250,000 square miles the Tohono O'odham Reservation is one of the largest in the United States, second only to the Navajo Reservation in size. It sits in the heart of the Sonoran Desert and includes a small portion of the Tohono O'odham formerly called Papago[4] original homeland. Today, there is very little development on this block of land, except for the small capital city of Sells and the various villages that remain scattered off of the main highway. In fact, from the main road, there is very little evidence of humans on the landscape at all except for an occasional cow that has lost its way and is found wandering along the side of the road as cars and monstrous RVs carrying retirees to Mexico lobbing past.

Like many reservations in the United States, the Tohono O'odham Nation is plagued by high rates of poverty, alcoholism, drug use, and diabetes. With most of the water having been diverted to neighboring Tucson and Phoenix, the Tohono O'odham no longer follow their traditional semi-nomadic lifestyle of traveling between flood plains during the summer and mountain springs in the cold, drier winter months. There is little industry or economy for jobs, so most of the young people leave for the city, or stay and fall into the cycle of poverty, perpetuated by unemployment.

Indeed, much of the landscape today hides the history of the land. But, the old folks will tell you about how it was—in the days when there was more rain, when the rivers would flood with torrential power and might during the summer months and crops were plentiful along the flooded plains. When whole families would convene in harvesting camps along the *playas* in June and July to pick and process the saguaro and organ pipe fruit. When extended families would travel up from Mexico across the border

[4] The Papago meaning "tepary bean eater" were given their name by Spanish conquistadors and changed their name to Tohono O'odham meaning "desert people". In addition to the Tohono there are also Hia Ced O'odham and Akimel O'odham or "Pima".

to listen to the winter stories around a fire. When the desert provided food, shelter, and story.

The opening of mines and introduction of cattle brought many economic, social, and cultural changes to this land and its people. Today, the mines sit vacant, scars along the landscape; silent proof of more prosperous times. Televisions have replaced storytelling and prepackaged chips and cookies replace the sweet fruits of the desert.

The Biophysical Environment

The Sonoran Desert is a region of profound biological and cultural diversity, home to more than 60 species of mammals, 350 birds, 100 reptiles and 2,000 plant species, 425 of which are edible to humans (Nabhan 2000). Rosamond Spicer's early ethnographic account of the Tohono O'odham captures the beauty and diversity of the Sonoran Desert.

> *"Where the valleys rise to the foothills, and continuing over most of the low ranges, paloverde, ironwood, and giant saguaro cactus are the main stands. On the foothills of the higher mountains is a shrub growth which includes false mesquite, yucca bear grass and grama grass, the latter excellent for forage, while on the summits of the Baboquivari Mountains are found oak and scrub pine. There are thousands of other varieties, some useful, some not; but those named constitute the principal plants in Papaguería. Not much large wildlife is left now, though there are a few deer, peccary, and wildcat, and infrequently, bear or wolf on the mountains. However, myriads of coyotes, rabbits, gophers, pack rats, and*

many varieties of birds thrive over the whole region. One keeps and wary eye, too, for rattlesnakes. After the rains of winter during which much of the vegetation has stood without sign of life, the desert bursts into bloom. The ocotillo thrusts shoots of red fire from the ends of its long spindly arms, the ironwood sheds a purple haze over hillsides, meadows spring into a riot of color --orange, blue, purple, white. Thorny mesquite and paloverde become clouds of bright yellow, turning into delicate green as the tiny leaves appear. Not so striking in panoramic view but equally beautiful are the perfect wax like flowers of the various cacti. As spring draws into summer, the bright colors fade into shades of green and brown and gray, overlaid by a film of tan dust, and in the late fall the deciduous trees lose their leaves. On the whole, the greatest change in color comes with the spring, but there is also the daily change of light and shadow: the brilliant sun and the glowering thunderheads, the blue and purple hazes over the mountains, the fleecy white clouds and the deep sky the sky that seems so much vaster over the desert than anywhere else."

(Spicer 1949:11)

Seventeen indigenous groups call the Sonoran Desert home as well as many who have settled in the region including Anglo, Arabic, Africans, Chinese, Chicano, and Latino. The Sonoran Desert is the hottest of our North American deserts, but its distinctive bimodal rainfall accounts for its high biological diversity. For me, all of this diversity of people and plants was not what I had conceived as a desert in the past since I like many others had always envisioned deserts to be desolate abandoned wastelands of

sand and mirage. Since living in the desert, I have come to understand that deserts are much more heterogeneous, encompassing a broad array of landscapes and living things. The defining characteristic of desert land is aridity and the fact that water is available only in limited quantities after rainfall (Dimmitt 2000). For the record, deserts typically receive less than 10 inches of rain per year. The Sonoran Desert is thought to be quite young in geologic time forming roughly 8 million years ago during the Miocene Period. Its distinguishing factor from North America's three other deserts (the Mohave, Great Basin, and Chihuahua Desert) is the presence of legume trees (e.g. Mesquite; *Prosopis* spp.) and columnar cacti (e.g. Saguaro, *Carnegiea gigantea*).

Humans have had a major impact on the landscape by constructing elaborate irrigation systems, exploiting surface and subsurface water and minerals, farming, and raising cattle. Some of the focal environmental problems today in the Sonoran Desert are biological invasions by non-native plants, habitat fragmentation, and groundwater overdraft (Nabhan 2000).

Figure 2.2 Grazing is still permitted in much of the desert. This has caused problems with exotic species invasions such as bufflegrass which aids in spreading fire along the landscape. Wandering cattle have also been known to cause traffic deaths, especially late at night along Highways 85 and 86. During my time in Ajo, four people were killed along these roads due to hitting a steer that had wandered onto the road.

Another issue causing unprecedented damage is illegal immigration and the current efforts to "secure our borders". In the 1990s the United States began to increase its enforcement of undocumented immigration in populated border areas of San Diego, California and El Paso, Texas. Using the analogy of a balloon, this localized enforcement caused illegal immigration and drug smuggling to be squeezed into more remote and less populated areas of Arizona without decreasing its overall volume (Segee 2006). Along Arizona's 350 mile border that it shares with Mexico are mostly wildlands, federally owned and protected. Some of the damage done by illegal drug traffickers, migrants and border patrol is damage due to road and wall construction, garbage, light projects, off-road patrols and low flying helicopters. These border enforcement symbols are so evident

on the landscape, that when an after school art class of elementary students from the Ajo Unified School District was asked to paint a picture of the desert, they included a Border Patrol helicopter (upper left corner) and an off-road vehicle (lower right) in their depiction.

Figure 2.3 Students' painting of the desert including Border Patrol helicopter and off-road vehicle.

A study conducted on the Tohono O'odham Nation estimated that the U.S. Border Patrol apprehended 500,000 people in 2005 and on an estimate of eight lbs of garbage per person totaling four million pounds of garbage left in the backcountry of Arizona alone, and the number keeps growing (Segee 2006).

With development increasing in this region, river flows are also expected to drop in the future. The Colorado River delta alone has shrunk to 50% of its size over the last 30 years, and municipal demand for water is expected to double in the Arizona along the border within the next 10-20 years (Ruiz 2000, Varady and Mack 1995). Sheridan (2001) notes that water has always been the limiting factor of human society in the southwest.

Up until the 19th century this was expressed in human adaptation to rivers, adjusting their settlement patterns and subsistence to the fluctuations of desert life. By considering the recent changes to the landscape caused by intensive agriculture, dams, ground water pumping, and over development it is clear that we are now forcing the desert to adapt to our own needs rather than adapting to life in the desert.

Some of the current conservation initiatives in the desert are protection of key plant and animal species, reduction of non native invasive plant species, protection of wildlife corridors and trying to reconnect people and culture to the natural environment. Organizations such as the Sonoran Desert Museum, Native Seeds Search, and the International Sonoran Desert Alliance (ISDA) realize the connection between biological and cultural diversity and have been working to "promote the concept and practice of conservation throughout the bio region and provide education in ways of protecting and respecting valuable biological and cultural resources and tradition" (ISDA website). Throughout my research, from the planning stages to data collection ISDA provided me with connections, insight, and introductions into the community of Ajo and the surrounding desert.

As development and modernization continue to increase throughout the region, people have lost much of their cultural and physical connections to the land and its resources. Population growth, immigration, and land conversion are occurring at rapid rates resulting in both environmental and sociological changes. Water that once flowed seasonally through *arroyos* or small washes and larger river beds supporting seasonal agriculture has been diverted to nearby urban areas, and people have followed the water in search of employment or city life. Extended families no longer live under one roof.

Rural children living along the border in towns such as Ajo, or in the remaining villages scattered along the Tohono O'odham Reservation now attend formal schools and often return home to a single parent household or remain in the care of a grandparent or aunt.

The Cultural and Social Environment

Humans have shaped the flora and fauna of the Arizona-Sonoran Borderlands for millennia. Because of its diversity of resources, the Sonoran Desert has a long history of human habitation dating back and estimated 10,000 years (Sheridan 2000). Over the years, various cultural groups have adapted their subsistence and settlement patterns to the arid often extreme environment. There is evidence of prehistoric animal extinction, crop domestication and irrigation development among the O'odham and Hohokam. These were heightened during the colonial period when overgrazing, deforestation, urban and agricultural development occurred. In 1848 land was transferred from Mexico to the U.S. under the Gadsden purchase. The frontier legislation, including the Homestead Act and the Desert Land Act, encouraged further development. The late 19th century brought mining-based population booms. Mexico was not enjoying these positive economic impacts until the 1920's and 1930s when tourism into Mexico became popular spurred by Prohibition laws in the United States At this time, prior appropriation water rights ruled in America while the government of Mexico controlled water use to commercial landholders and the communal *ejido* sector.

Extensive environmental knowledge of animals, medicinal plants, wild foods, and weather patterns were vital to survival in the desert since their subsistence depended upon intimate knowledge of local ecology. Desert dwellers often derived cultural identification

with the most salient plants and animals on the landscape. For example, the Tohono O'odham, meaning "Desert People" mention over 26 distinct species of plants in folk stories (Nabhan 2000) and even fashion their calendar according to the lifecycle of the saguaro cactus.

So, how were humans able to live in such a fluctuating, unpredictable and often harsh environment for such a long time? Hackenberg and Benequista (1983) has attributed the key to the success of humans in the Sonoran Desert to diversification. The wide range of subsistence activities and settlement patterns used by human populations here are adaptive mechanisms required to cope with the range of variation of available flora and fauna from year to year. The Hohokam, Prehistoric Indians and desert farmers living in this region thousands of years ago left their mark on the landscape with remains of elaborate irrigation systems winding some 200 miles across the desert, which they used to grow maize and cotton. They were surely using fire, hunting, harvesting fuel wood and gathering wild foods, all which would have left evidence on the landscape, but it is still widely disputed just how much of an impact did they have on the flora and fauna of the desert. Archaeological evidence at Hohokam field sites shows that as Hohokam settlements grew larger and more sedentary, animals bones changed too, showing less deer, bighorn sheep and antelope and more rodent, cotton tail, and jackrabbit. This suggests that the Hohokam may have helped hunt some of the larger Pleistocene mammals to extinction (Sheridan 2000). Nobody knows if the collapse of the Hohokam had an environmental or political cause, but when the Spanish arrived in 1600 they were gone. What is sure is human impact on the landscape was perhaps more subtle and benign in the past, and has been growing and intensifying ever since.

The Tohono O'odham have lived in the region for an estimated 400 years. They are thought by many to be the descendants of the Hohokam, however, O'odham and Papago creation myths tell a much different story. They betray themselves as the conquerors of the Hohokam, not their descendants (Bahr 1971). Regardless, the cultures share many things including language which both belong to the Uto-Aztecan language family, and farming and irrigation techniques. The Akimel O'odham or Upper Pima as they were called by the Spanish lived along rivers and dug canals similar to those that the Hohokam used to irrigate their crops. The Tohono O'odham were semi-nomadic seasonal farmers living near mountain springs in winter and on arroyos in the summer, building ditches to collect water runoff along alluvial floodplains from seasonal monsoon rains in the summer (Dobyns 1972, Fontana and Shaefer 1981).

Rea (1997) describes the relationship that the O'odham people have with the land and its biotic resources as a symbiosis that survives in a limited extent in the 20th century. This is evidenced in their subsistence and settlement strategies described above, and their rituals, oral traditions and language, often encoded with intimate knowledge of desert flora and fauna. In an annual ceremony called *wi: sheg* or 'throwing up the clouds' the Tohono O'odham practice a ritualistic ceremony of harvesting saguaro cactus fruit and making *nuwait*, a wine derived from the fermented juice. During the festivals, people sing and drink *nuwait* often to the point of sickness. The ceremony happens every year in July just before the coming of the monsoon rains as a way to beckon the clouds and is symbolic as a means to purify the body, soul, and land. Dr. Ofelia Zepeda, an O'odham linguist and poet at the University of Arizona describes the beckoning of the rain in the following poem:

"Pulling Down the Clouds"

N-ku'ibagkaj 'ant o 'ols g cewagi
With my harvesting stick I will hook the clouds.
'Ant o 'i-wanno k o 'i-hudin g cewagi.
With my harvesting stick I will pull down the clouds.
N-ku'ibadkaj 'ant o 'i-siho g cewagi.
With my harvesting stick I will stir the clouds.

With dreams of distant noise disturbing his sleep,
the smell of dirt, wet, for the first time in what seems like months.
The change in the molecules is sudden,
they enter the nasal cavity.

He contemplates that smell.
What is that smell?
It is rain.
Rain somewhere out in the desert.
Comforted in this knowledge he turns over
and continues his sleep,
dreams of women with harvesting sticks
raised toward the sky.

O'odham creation tales also provide specific plant and animal terms and information. For instance, in "Earth Magician", seven wild desert foods and their habitats are mentioned such as mesquite, cactus, corn, grass, melon, squash and beans and over a dozen animals including eagle, thrush, woodpecker, wren, cougar and peccary (Benedict and Bahr 2001). Hughes' (1996) research focuses on plant emergence narratives which are oral traditions that illustrate and articulate Tohono O'odham relationships with the desert botanical community. She cites O'odham stories as a way of translating knowledge about the interconnectedness of people and local ecology to the younger generations. Nabhan (2000) believes that indigenous people who have lived in habitats for centuries encode traditional ecological knowledge about interactions between species into language and use oral traditions such as songs and myths to remember, transform, and culturally transmit this knowledge.

The arrival of Europeans in the 16th century brought great changes to the region. Europeans carried with them deadly epidemics that spread like wildfire up river corridors, killing many Native Americans. But they also contributed new crops such as wheat, new tools, and cattle. Indeed cultural contact brought problems for the O'odham along with new opportunity. When cultural contact occurs, this can lead to introductions of new disease pathogens, deadly weapons, alcohol, a more sedentary lifestyle, changes in nutritional patterns, the acceptance of paid work, growing of cash crops, and the deliberate alteration of ecosystems. One of the most physical manifestations of culture change can be seen in diabetes in Native American populations (Wirsing 1985). Diabetes has been attributed to the diet change of the Tohono O'odham that has occurred since European contact (Nabhan 1987, Smith-Morris 2004, Wirsing 1985). Wirsing(1985) and Smith-Morris (2004) state that the rate of diabetes among the Pima and Tohono O'odham are among the highest in the world.

Border populations have both endured and become agents of continuous change adapting to new political and cultural circumstances, and not ever fully assimilating to the majority culture, but rather molding them to fit their own needs (Sheridan and Parezo 1996). While traveling along Highway 86 across the Tohono O'odham reservation and in the town of Ajo, the long cultural exchange of the Anglo, Mexican, and O'odham culture can be seen through symbolic representations. For example, when the Jesuit missions arrived they brought with them Catholicism, and many O'odham converted. However, the O'odham never totally assimilated to this new found religion but rather integrated it into their existing worldviews.

Fig. 2.4 A crucifix at the Darby Wells Cemetery overlaid with I'itoi, the creator of the O'odham people and his maze, a symbol of Tohono O'odham worldview and identity representing one's path through life. The combining of the two belief systems represents a resistance of the O'odham to totally assimilate to Western culture.

Some of the details of my November 1st trip to *el Día de los Muertos* or Day of the Dead in Sonoyta, Mexico, a border town south of Ajo along Highway 85, illustrate the blending of the O'odham, Mexican, and ranching cultures and belief systems. Excerpt from field notes November 2, 2006:

> *"I just returned from Sonoyta where I spent the day with Janet's family at the Sonoyta cemetery on Obregon Rd. for el dia de los muertos. When we arrived at the cemetery around 1:00 pm, the dirt parking lot was already beginning to fill with cars. Right where we pulled in people were unloading yellow and orange puffy marigolds off of pick up trucks, cutting them and placing them in bouquets in the parking lot. Flower stands lined the entrance way into the cemetery. Janet's family "camp" was located*

just to the right of the entrance. Each of the family camps included a semi-permanent structure for sun shade. Some of them are even more elaborate large tent structures with tables, chairs and hammocks for a nap. In and around the cemetery there were horses and outdoor kitchens for cooking Indian fry bread or popovers. Popovers are an O'odham creation consisting of fried wheat tortilla dough resembling a donut, topped with red chili, beans and lettuce and cheese resembling a Mexican taco. The red chili comes from ranching recipes of slowly simmered beef in a red chili sauce. Brass bands are playing a style of music called banda made up of several brass instruments. There are women in dark jeans, cowboy boots or heals, fancy black thick bejeweled sunglasses and crisp white shirts typical of a ranchero style of dress. The men are wearing their best darkest jeans with plaid shirts, boots, and white straw cowboy hats. Some of the women are busily cooking over outdoor stoves. There are also kids everywhere running, playing, and exploring the landscape and I think to myself they have so much freedom! Rather than a solemn procession which is typical of the cemetery visits I have attended, there is dancing, talking, eating, singing and laughter.

Some families sit in circles on fold up chairs around the gravesites while others are drinking talking and visiting with one another. The graves were decorated so beautifully! There were lots of silk and fresh flowers. Some families had food set out—cakes, cookies, candy skulls and salt. I asked what the significance of the salt is and was told that it purifies

the soul in the next lifetime. Families were also sweeping off the gravestones, painting them and otherwise making them beautiful. We enter a mausoleum where the bottom of the floor was covered, every square inch, in bright yellow marigolds; the effect was breathtaking. I later found out that the grave was from a little boy who died in a horse riding accident.

Most of the day we spent sitting listening to the thunderous band, wandering around, eating, and talking. We decided around 4:30 to start to head back to Ajo so we didn't have to drive the Organ Pipe road after dark. As we were leaving there were hoards of cars coming into the cemetery. I could feel the energy increase. The drinkers were arriving. There were also a busload of kids who had arrived from the local school. It was about to get crazy. People were getting big bon fires ready since it was turning cool. It was going to be a long night, and if we hadn't needed to drive back I would have liked to stay and joined the party."

As mentioned earlier, evidence of ranching exists along landscape in various forms. One of the practices that was typical was to create a 'dirt tank' in order to provide a water source for cattle. This involved digging a trench and allowing the cattle to stomp it down with their hooves until the ground was compressed enough to hold water. This basin was then filled with rain water. A few of these dirt tanks still remain now, but with the restriction of cattle grazing on much of the land surrounding Ajo (cattle grazing still does occur on the Tohono O'odham reservation and on certain areas of the desert that

were grandfathered in) they are no longer used by ranchers. Now, these wells fill with water during the summer monsoon rains and remain an important source of water for desert animals and migrating bird species. The photo below was taken 5 miles south of Ajo just off of Highway 85 in August. That day, I counted five species of birds including ducks.

Fig. 2.5 Dirt tank located south of Ajo.

Today, the region remains a tri-cultural area combining traditions and cultures from the Tohono, Mexicans, and Anglo ranchers who through continuous contact have been sharing information in cultural exchanges for over 100 years as evidenced by a blending of traditions in their clothing, food, and religion.

An Ethnographic Overview of Ajo, Arizona

Figure 2.6 The central plaza of Ajo, Arizona. The train depot (left) which is no longer in use was operated by the Cornelia Gila Bend railway line, traveling from Ajo to Gila Bend. Churches and business surround the central park, which maintains its non native vegetation with heavy watering year round. It is a central meeting place for community events and informal gatherings.

Ajo is a rural town with a population of 3,705 (US Census 2000) located at an elevation of 1,798 feet above sea level, 40 miles north of the US-Mexico border in the heart of the Sonoran Desert. Ajo is approximately 110 miles from Phoenix and 131 miles from Tucson, and is a gateway for people traveling into Mexico, to the Organ Pipe Cactus National Monument, or to the Tohono O'odham Indian Reservation (and its popular casino).

Figure 2.7 Map showing the location of Ajo, AZ.

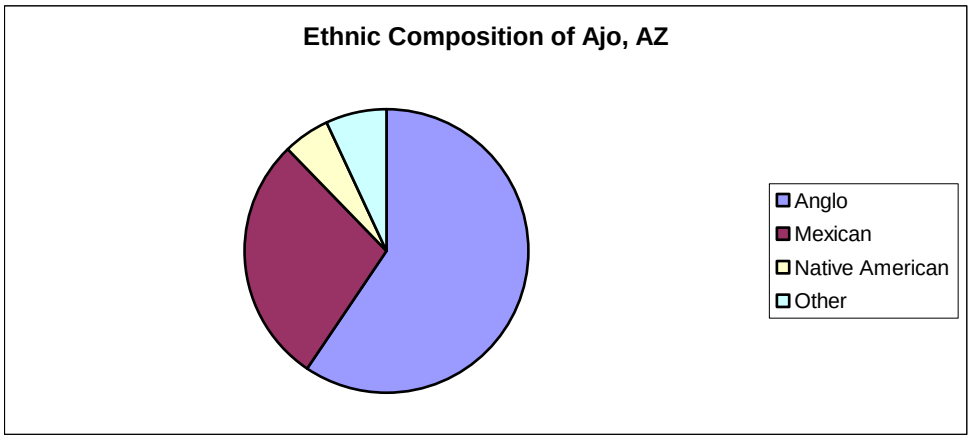
Locals will tell you two competing stories for how Ajo got its name. The first and most obvious is that it is named after the Spanish word *ajo* for garlic. There is a wild garlic called the Ajo lily (*Hesperocallis undulata*) or desert lily that is an onion-like plant that grows in the hills surrounding Ajo. The second theory is that the name comes from the O'odham word *o'oho* for paint. Legend has it that the O'odham obtained red paint pigments from mines in this area. The Spanish, not understanding their language, may have named the place using the familiar word "ajo" in place of the similar-sounding O'odham word.

The climate of Ajo is hot and dry with an average high of 83.9 degrees and an average low of 58.9 degrees Fahrenheit. Annually, the town of Ajo, AZ averages 8.5 inches of rain. Due to the mild winter temperatures, Ajo's Chamber of Commerce has coined the phrase "Where Summer Spends the Winter" in order to attract visitors and retirees.

Demographics

As of the most recent census in 2000, there are 1,659 households, and 1,088 families residing in Ajo. The population density is 132.0 people per square mile (51.0/km²). The ethnic makeup of Ajo is 78.70% White, 37.57% Mexican, 6.88% Native American 0.24% Black or African American, ,0.30% Asian, 0.08% Pacific Islander, 9.15% from other ethnicities. This ethnic makeup seems to reflect a skewed view of Ajo's population. It is my guess that many of the retirees, who are primarily white or "Anglo", a commonly heard term, claim Ajo as their year-round residence.

Table 2.1 Ethnic composition of Ajo, Arizona.



There are 1,659 households out of which 19.7% have children under the age of 18 living with them, 51.4% are married couples living together, 10.6% have a female householder with no husband present, and 34.4% are non-families. Approximately 30% of all households are made up of individuals and 17.1% have someone living alone who is 65 years of age or older. The last statistic could again be caused by the presence of retirees in the community. The average household size is 2.23 and the average family size is 2.74.

The population breakdown is 20.6% under the age of 18, 4.9% from 18 to 24, 17.2% from 25 to 44, 25.3% from 45 to 64, and 32.1% who are 65 years of age or older. The median age is 52 years. The Ajo economy is made up primarily of tourism, services, and commercial industry. Since Highway 85, the main road through town, is along the way to Organ Pipe National Monument and the popular Mexican beach destination of Puerto Peñasco or as the gringos call it “Rocky Point”, many of the business along this road cater to the tourists selling gas, liquor and beer, Mexican insurance, and fast take-away food.

The median income for a household in the most recent census is $25,618, and the median income for a family is $29,310. Males have a median income of $28,000 versus $18,571 for females. The per capita income is $14,548. About 16.5% of families and 22.3% of the population are below the poverty line, including 36.5% of those under age 18 and 9.0% of those age 65 or over.

Ajo Settlement

As you enter into town, the first site you see is a beautiful plaza with Spanish Colonial architecture evoking more prosperous times (see Figure 2.6). This is the Ajo Plaza, a Spanish Colonial Revival town square built in 1917. The plaza is lined by tall palms and surrounded by mission churches and Spanish-style buildings. Today it is used as a central gathering place for community events. Several businesses also line the plaza including a pharmacy, U.S. postal office, café, real estate office and Pima County Library (with Tucson as the county seat).

At the far east side of the plaza is the old train depot which at one time served the Tucson, Cornelia, Gila Bend railway. Directly west of the plaza is the historic Curley School built in 1919 it once housed the grade school and high school for the town. Recent renovations by ISDA have restored it to its original beauty and now, the school housing a small artist community with artist's living quarters and studios.

I discovered Ajo while doing research on the internet for information on the Sonoran Desert. My first arrival in Ajo was in the June 2002. I had received an ethnographic training grant from the National Science Foundation to conduct a pilot study at my field site in order to test research methods and to hone my research questions. As I mentioned earlier, I had been to Tucson numerous times, but had never ventured outside of the urban areas to a place as remotely located as Ajo. However, in my naivety, I figured that it was probably about the same as Tucson, just on a smaller scale and that although it was summer it could not be much hotter than some of the summers I had spent in the Southern Appalachian mountains where I had attended school at Ohio University without air conditioning. As it turns out, I was wrong on both counts.

Excerpt from field notes January 3, 2006:

As I continued on Highway 86 that June morning I approached a curve and the highway began to transverse a rocky outcropping of granite boulders, snaking its way around desert scrub and towering saguaro cacti. Finally, the remote desert highway gives way to a sign for "Coyote Howls East", a home site for 600 RVs during the busy winter "snow bird season". Now, the place was empty with only an open gate and a dog lazily walking through the dusty parking lot. Directly to the west of the lot, further down the highway a large sign announcing the Ha San O'odham for "Saguaro" Casino could be seen towering over a small adobe gas station and side building containing slot machines. I stopped at the station to get something to drink and some gas since this is the first station that I had seen since Sells, nearly 60 miles away.

I hop back into my car and hang a right out of the station back onto the highway. The road continues for another mile before ending at an intersection with a sign reading "Welcome to Why, Arizona" Mexico 30 miles to the left, Ajo 10 miles to the right. There are several stories as to how Why got its name that I had picked up on my previous trips to the area. One story is due to the shape in the road where Highway 86 intersects with Highway 85 that runs north and south from Phoenix to Mexico. The other story is often chuckled about by locals as one of 'Why would anyone want to live here?'. As I looked around at downtown Why, which consisted of the intersection, a Chevron gas station on the east side

of the highway and the Why Not? gas station on the west side of the highway, I began to think the latter explanation may very well be the most correct.

I turned the car north and headed up toward Ajo. As I drove up the road a large pile of rock began to come into focus along the horizon. It stretched from one side of the highway to the next. I had read that Ajo had once been the site of one of the largest open pit mines in the world, and that it had shut down in 1985, yet was still so enormous that its tailings pile could still be seen by satellite. Nevertheless, I had never imagined the enormity of this hole in the ground.

Figure 2.8 The now closed open pit copper mine in Ajo, Arizona.

Ajo had once been a true boom town[5]. It was first discovered in 1847 by Tom Child's Sr. on his way to Magdalena, Sonora, Mexico. Soon his friend Peter M. Brady formed the Arizona Mining and Trading Company which mined surface ores and operated until 1857. The next person to develop the Ajo area was General John Campbell Greenway, a Rough Rider who became the general manager of the Calumet and the Arizona Mining Company. Later, Calumet and Phelps Dodge merged in 1931 and the mine became known as the New Cornelia Branch of Phelps Dodge managed by Michael Curley. The mine was operated as a copper mine although turquoise and silver had been found as well. The mine drew a diverse group of workers from as far away as Georgia and at its peak employed 13,000 men. It closed in 1986 after a bitter strike and although the rumors of reopening remain alive even today, there has been no copper taken out since that time.

There were Anglos, Mexicans, and O'odham working at the mine since about 1910. The mine jobs were stratified by ethnicity. The Anglos were the mine managers and held the white collar jobs, the Mexicans were often the mine engineers, and the O'odham were the workers and blasters. This social stratification formed the basis for the building of the town and the design of the neighborhoods. The closest settlement to the mine was the Indian Village. People have shared with me accounts of the blasting from the mines being so loud that their windows would be blown out from the explosion, and they remember Phelps Dodge employees replacing their windows on a near weekly basis (the homes were company houses).

[5] The following stories of the mine founding, history of mine settlements, and photographs were collected through numerous interviews with older folks in town and archives at the Ajo Historical Society Museum.

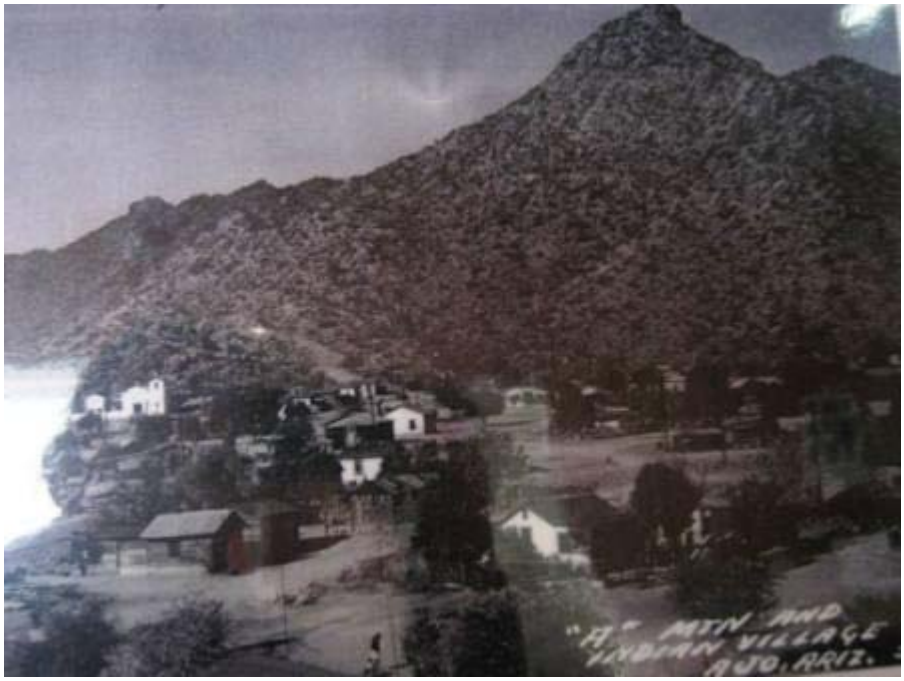


Figure 2.9 A photo of Indian town with the Jesuit mission in view in the left rear and the mine in partial view on the far left. The Jesuit mission is all that remains today and is now home to the Ajo Museum and Historical Society.

Mexican Town was slightly further back from the mine. It was larger and consisted of a lower area, simply referred to as Mexican Town and an upper level where Mexicans of higher status living called “Tortilla Flats”. All that remains today of this village are the foundations from the homes, which were small concrete structures also owned by the Phelps Dodge Corporation. Several people that I have spoken with about their experiences living in Mexican Town describe it as a very nice place to live where ‘everyone knew everyone and looked out for one another’. Mexican town was in a way self sufficient as it had its own stores, soccer field, and church.

Figure 2.10 A reconstruction of Mexican town located at the Ajo Museum and Historical Society. This model, compete with family names from each house was labeled by one man who grew up there as a child and had an amazing ethnographic memory.

The Anglo mine managers lived on the other side of town furthest from the mine. The homes were owned by Phelps Dodge as well and were one of three floor plans. Two bedroom, one bath, two bedroom two bath, or three bedroom two bath. One woman said that her family paid $25/month rent while she was growing up in the 1950s. After the mine closed in 1985, the homes were sold to locals and retirees for prices as low as $8,000.

Today, the town is much the same as it was back then with the exception of Indian and Mexican Towns. The Phelps Dodge company homes, now privately owned, are located mostly north and east of the plaza. Old adobe homes made from dried mud and grass can still be found scattered throughout town (see Figure 2.11). Other houses are called ‘tent houses’ because they were constructed literally from temporary tents set up

during Ajo's mining boom into permanent wood structures. These can be found scattered throughout the town. Several miles north of the central plaza is an area called 'Five Acres'. The land in this part of Ajo was originally sectioned and sold as five acre plots, used mostly for ranching. Today, these land plots have been further subdivided. Because ranching is now prohibited on most of the U.S. Bureau of Land Management land surrounding Ajo, the Five Acres is now made up of ranch style homes where many people with horses choose to live.

Figure 2.11 My home, one of the early adobe houses built to stay warm in the winter and cool in the summer. The mesquite tree in the foreground provided welcomed shade during the hot summer months.

Education and Socialization

The Ajo Unified School District is the only school district in Ajo, Arizona. There is currently an elementary school, junior high school, and high school, all of which are located in the same area. The high school currently has a football team, basketball team

(both boys and girls) , baseball team (boys), softball team (girls), golf team, and track & field. They are known as the Ajo Red Raiders. The elementary, middle and high schools all sit on one campus, clustered at the eastern entrance to the town. Students come not only from Ajo, but also from the nearby border towns of Mexico and the Tohono O'odham Nation. The graduation rate for the high school is low as the drop out rate is high among high schoolers. There is also a great deal of turnover of the student population. A teacher shared her concerns with me over planning for the upcoming years. Because of the dynamic student population, it was hard for teachers to know students' educational backgrounds. Furthermore, more and more students speak Spanish as their first language, especially in the lower grades which is a challenge in a school system where all the instruction must be in English. Children fall behind quickly and some never catch up due to challenges with English instruction.

Figure 2.10 The Ajo middle school (foreground) and high school can be seen toward the rear of the photo. The courtyard in the center is a meeting place for students during lunch and before and after classes.

Because most of the occupations in Ajo now revolve around the service industry rather than farming or ranching, there is not a real need for adults or children to know more than rudimentary practical knowledge about the desert. A small number of adults are employed by the nearby park service and wildlife refuge and these families having more direct contact with the environment tend to participate more in outdoor learning activities like bird watching or desert hikes. Those employed by the US border patrol are required to have a general knowledge of desert plants and animals and often times during interviews a student would mention that their mother or father was in the border patrol and had taught them about a certain plant or animal.

While spending time with families that befriended me, seldom did I see children harvesting desert foods or venturing out on long excursions to gather plant materials for much else than mesquite wood for burning. However, adults often still harvest cactus fruits, gather mesquite pods or wood for fires and ocotillo branches to construct fences and some keep native gardens. On the other hand, children's interest in the desert is rather limited to recreation use, including horseback riding, atvs, hunting, and camping.

Figure 2.12 Several children perform traditional Mexican dancing during the International Day of Peace festival in the Ajo Plaza.

Today, much of the social life in Ajo is centered around the churches, the school, and the population of 'snowbirds' or retirees that come from all over the United States to live in Ajo during the winter months. This population, accounts for over half of the visitors to Ajo during winter months. The town is now a snowbird destination with an estimated 1,000 or so "winter visitors" as they are called arriving every year beginning in November and leaving in April. The winter visitors have started many social and service clubs such as the Lion's Club, Free Mason's, the Ajo Garden Club, the Chu Chu Club, and many more. Although the town is not officially segregated there does remain a separation of social activities embedded within the social structure of many of the community events. This is not to say that there are not several groups and activities that do reach out and draw group participation from a diverse mix of people. Organizations such as ISDA have been organizing programs specifically for this purchase, to bring together multi-ethnic as well as multi-generational groups for community events. One of

the organization of which I became a member , the Chu Chu Club was also called the American Citizen's Social Club in its early years. The club was created in order to assist Mexicans with obtaining American citizenship and provided a social network. Today, it remains an active organization and is one of the few public places in Ajo where I consistently saw Mexicans and Anglos socializing.

Children and youth in Ajo are left without a lot of social options during their free time. During a conversation with a local woman who facilities a group for girls on how to lower teenage pregnancy she mentioned that one girl said that the number one cause of teenage pregnancy was 'boredom'. Many of the public places in Ajo have limited access to children and youth activities such as skate boarding or bike riding.

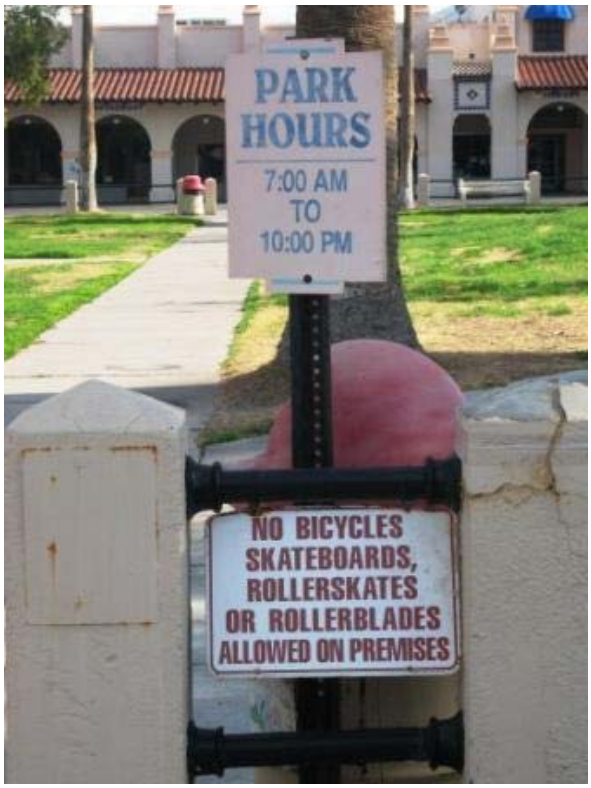


Figure 2.13 Signs posted at the Ajo central plaza prohibit recreation.

Figure 2.14 Further example of the limited number of spaces for children and youth in Ajo.

Recently a skate park was constructed and is managed by Pima County Parks and Recreation, providing outdoor recreation opportunities for youth. During interviews, student participants reported a wide range of free time activities ranging from spending time indoors or listening to music with friends to playing sports and riding bikes or atvs in the desert. Figure 2.15 depicts a community created raceway for atvs, just north of town on Bureau of Land Management Land.

Figure 2.14 Community created raceway for atvs. This is a popular pastime for youth and families on the weekends.

Cultural Diversity and Revitalization

As mentioned earlier, Ajo has been a tricultural town for over 100 years due in most part to the mine drawing people from as far away as Georgia for employment. What remains today is a population of multi-cultural and multi-ethnic people. Several informal conversations with people from each ethnicity revealed that choosing one's cultural boundaries and representation can be difficult in Ajo. For example, if a person who is of O'odham and Mexican descent decides to participate in Mexican cultural events such as Day of the Dead festivals or traditional Mexican dancing, they will sometimes be teased and are accused of trying to be too 'Mexican' and are asked 'why don't you go back to Mexico then if you like it so much?'. Likewise, if the same person participates in

O'odham cultural events, the are blamed for pretending to be 'Indian'. The mixing of ethnicities and cultures proved particularly difficult to determine a participant's ethnic background. Conversations with teachers and counselors had revealed that even if children were part O'odham, they would often call themselves Mexican instead. One way that I tried to address this issue was rather than asking the participant for their ethnicity, I used 'parent's first language' and 'grandparent's first language' as a proxy for ethnicity.

Today in Ajo there is an interest in revitalizing cultural knowledge about local resources in order to promote conservation of the Sonoran Desert. Due to this interest, several community groups including the International Sonoran Desert Alliance as well as government agencies like the National Park Service and the Cabeza Prieta National Wildlife Refuge have begun environmental and/or culturally based programs targeted specifically at children/teens.

One of the reasons that I chose Ajo for the location of this research is that while children's loss of nature knowledge has become a more popular topic and has been researched in many parts of the world, very few of these studies are conducted in the United States. Or when they are, they only include urban or suburban areas. When carrying out a literature review while preparing for this research, I found very few studies that were located in rural areas of the United States like Ajo. Ajo is an interesting place for such a study because of its remote location surrounded by desert wildlands, proximity to Organ Pipe and Cabeza Prieta, its unique history, and its cultural diversity.

This chapter provided an overview of the biophysical, social and cultural history of the region. Ethnographic detail on the town of Ajo reveals a history of multi-ethnic populations who have had cultural contact for over a century sharing traditions and

information during this time. The following chapter details some of the theory on knowledge systems including cultural transmission and acquisition of knowledge, learning in social, cultural, and ecological context, knowledge change and loss, and cultural and generational variations in knowledge. In Chapter Three, I will present the framework for the research design and methods including how the methods relate to the overall research goals and questions of this dissertation.

Chapter 3

Measuring Variability in Cultural Context:

Research Design and Method

Figure 3.1 A crestated saguaro cactus, a unique variation with unknown cause just south of the United States and Mexico border. Note the wavy appearance of the flesh, and the absence of arms, replaced with a crown like crest on top.

The social distribution, transmission, and evolution of ecological knowledge represent increasingly important topics of research in ecological and environmental anthropology (Berlin 1992, Hunn 2002, Zarger and Stepp 2004, Zent 2001). Interest in

ecological knowledge has shifted from a synchronic, homogenous view of knowledge to a focus on the diachronic properties of knowledge in a heterogeneous and rapidly changing social and physical environment. This shift in focus has prompted researchers to not only document the content of what is known, but also to investigate the process by which it is acquired and shared in order to explain the impetus behind knowledge transformation and /or loss (Godoy 1997, 1998, Ross 2002, Zarger and Stepp 2004, Zent 1999, 2001). Processual qualities of knowledge systems includes such topics as cultural transmission and acquisition of knowledge, learning in social, cultural, and ecological context, cognition and memory, knowledge change and loss, and cultural and generational variations in knowledge. This chapter is an overview of theory on measuring variability in cultural knowledge systems and will describe how the methods will provide data to answer the overall research question: "Does ethnobiological knowledge vary based on learning contexts?"

Measuring Variation

When considering ecological knowledge, it is easy to make the false assumption that this knowledge remains unchanged or frozen in time, but this is not the case. Perhaps knowledge is stable when considered over a long period of time, but dynamic in the short term, varying within and between generations. Ethnoecologists have recognized this variation and change, and research that addresses the dynamic qualities of knowledge are increasing. Rather than relying on one or two cultural informants to understand cultural knowledge, researchers are now looking for patterns of variation among individuals, both

novice and expert, to better understand how knowledge is acquired, transmitted and distributed throughout the community.

Boster (1986) found marked differences between men and women's knowledge of manioc among the Aguaruna of Peru. Garro (1986) studied the medical knowledge of curers and noncurers in a Tarascan community in Mexico and found that differences could be attributed to different levels of experiential learning. Weller (1987) and Weller and Baer (2002) use the theory and method of cultural consensus analysis (from Weller and Romney) to measure within and between group variability in knowledge.

Assumptions

Several assumptions grounded in theory on acquisition and transmission of ecological knowledge were made in order to construct the research design. Because the purpose of this study is not to determine the developmental stages in children's acquisition of knowledge, young children were not included as participants. Previous research demonstrates that by age 12, children have acquired most of the plant and animal knowledge that they will have as adults (Hunn 2002, Reyes-Garcia et al. 2005, Stross 1973, Zarger 2002), and by that age developmentally, children are able to grasp abstract concepts and reasoning necessary for the completion of the interviews (Holmes 1998). Therefore, only children 12 and older were included as participants in this study.

The research design assumes knowledge to include naming and recognition competence of plants and animals. The way in which knowledge is acquired and transmitted involves a dynamic process, embedded within social interactions and community practices. Children and adults will continue to acquire and extend knowledge

gained in early childhood to novel situations throughout their lifetime. However, in order to look at within and between generational variation, it is necessary to take a 'snapshot'of what is known at a given point in the individual's lifetime. In doing so, it is assumed that differences in content of knowledge between children and adults is not solely based on age (i.e. adults are older, and thus have by default gained more experience and knowledge than children). Rather, differences in the content of knowledge are also a consequence of the learning context (social versus abstract) and interactions in which the knowledge was first acquired. In this regard, it is expected that differences will occur along a continuum; the content of knowledge among children lacking any situated learning will vary from children who have had more situated learning, which will also vary from adults who are assumed to have the most situated learning. Structured interviews will address differences in learning contexts by inquiring how (from whom and in what setting) the participants learn about each plant or animal referent.

Research Design

The research design was to complete structured interviews about Sonoran Desert plants and animals with 110 students (Anglo, Mexican, and O'odham) in 7-12th grades and an equal number of their parents and grandparents in order to identify variation within and between generations. The comparison of multiple generations would allow for the identification of species that were recognized in the older cohort but no longer recognized in the younger cohort.

My first challenge was to decide how to decide which plants and animals I would use as referents during my interviews. With the large number of plants and animals in the

Sonoran Desert I would need to somehow narrow down the pool of referents to a more approachable number so that the interviews could be consolidated to last less than one hour. As previously noted, past ethnobiological research was conducted primarily with experts, usually adults, who were more than willing to take a couple hours of their time to discuss a topic of obvious interest to them. However, working with children as primary informants, most being novices on the subject, meant that I would need to keep the interviews shorter. In fact, previous research with children has shown that interviews lasting 20-30 minutes work best (Holmes 1998).

So, tasked with the job of narrowing down the pool of possible referents I decided to employ two different selection methods. First, I turned to the ethnographic literature that had already been conducted in the region among Mexicans and Tohono O'odham. By reviewing former ethnobiological studies and folklore from Rea (1997,1998 and Underhill 1978) I comprised lists of the most frequently mentioned plants and animals. Then, in order the corroborate these findings, I conducted expert interviews with 12 individuals upon first arriving to my field site in Ajo in order to collect free lists (this procedure is explained more in-depth below) and talk informally about desert plants and animals. Having visited Ajo two summers before and conducted preliminary research on my topic, I had been fortunate to have met several individuals who themselves knew much about the Sonoran Desert or who knew individuals who knew knowledgeable individuals. By comparing the lists made by these individuals with the lists from the literature, I was able to narrow the most culturally salient plants and animals to 25 animals and 20 plant species. The following are the selected species including ethnobiological content on names, uses, and cosmological beliefs. They are listed with

the scientific name and include the common English, Tohono O'odham and Spanish names. The descriptions are based on informal interviews with my research assistants and other knowledgeable experts in the community during the course of my stay. For additional references see Hodgson (2001), Nabhan (1982, 1987, 2000), Rea (1997, 1998) and Underhill (1978).

Plant Descriptions

***Agave* spp. (agave, mescal, century plant, a'o't, agave)**

The leaves and stalks are roasted and the flowers boiled and eaten. It is used for to make tequila. Its fibers are strong and were once used for baskets. agave fibers used for bowstrings, brushes, cradles, nets, shoes, skirts, mats, rope and other clothing. I did not meet anyone who still harvests the plants for its fibers.

***Nolina microcarpa* (beargrass, moho, palmilla)**

Its fibers used by the Tohono O'odham for weaving baskets.

***Capsicum frutescens* (bird pepper, tcirtipin, chiltepin)**

The pepper is dried and then ground and used as a spicy condiment on beans and meats. Also has antiseptic qualities. Usually found growing in the mountains. Many people told me that it's the 'mother' of all other chili peppers. The peppers are sold by the pound in Mexico and are quite expensive.

***Encelia farinsa* (brittle bush, tuhar, rama blanca, incienso)**

Medicinal for eyes; plant has sticky sap. Fragrant and used for burning. Commonly found growing in yards in Ajo and along the roadside.

***Opuntia fulgida* (chainfruit cholla, jumping cactus, ha:nam, cholla)**

Buds were baked, boiled and eaten. Sometimes buds were eaten raw. The thorns are removed by rolling buds in a basket with greasewood twigs as a brush or by using gravel. Many people mentioned that you could get sick from eating too many.

***Larrea tridentata* (creosote bush, greasewood, rain tree, ségai, hediondilla, gobernadora, chaparral)**

More names than almost any desert plant which demonstrates its salience in this community. It has medicinal antiseptic qualities and is used for arthritis, and intestinal and respiratory infections. Its sap is used to mend pottery and waterproof baskets. Kids and adults said that a branch is broken off and placed in a swap cooler (the evapo-transpiration system used to cool desert homes) to freshen the house and disinfect the water.

***Datura* spp. (jimsonweed, sacred datura, kótdop, datura, loco weed)**

Once used in ritual ceremonies by the O'odham. It has strong hallucinogenic properties. Many view this plant as taboo. Children are warned in school and at home not to touch this plant and that it is 'dangerous'. Several people told stories of watching people who had eaten the plant which made them *loco* or crazy. The plant grows widely in *arroyos* or washes and where water collects along the roadside and under bridges in Ajo.

***Proboscidea parviflora* (devil's claw, unicorn plant, ihu'k, uña de gato)**

Outer covering of the pod when dried turns black; fiber used to make black designs in baskets; seeds are eaten during times of low harvest. The devil's claw would hook onto the legs of cattle and be spread. Now it is fairly uncommon to find the plant

growing in town, but they still grow further out in the desert and on land that is still grazed.

***Olneya tesota* (ironwood ho'idkam, palo fierro, tésota)**

Wood used for crafts and fires due to its strength and long burning properties.

***Simmondsia chinensis* (jojoba, hohowai, jojoba)**

Supplemental food to provide nutty flavor; powder of ground beans made a coffee-like drink. The oil is used for shampoo, sores or skin problems, eye soreness; oil was prepared by cooking fruits in hot ashes and crushing them. It was sometimes burned and then rubbed on the face as makeup for eyebrows.

***Prosopis* spp. (Mesquite, kui, mesquite)**

Seed pods crushed and eaten or ground into a fine flour and used for baked goods. Also mixed with water for a nourishing drink. Its aromatic wood is used to flavor meat. The mesquite grows abundantly in and around Ajo.

***Ephedra* spp. (mormon tea, skinny weed?, kawaiisu, and popotillo)**

Chewing raw stems relieved thirst and hunger while hiking or riding out in the desert. A tea made from stems and steeped for 20 minutes is used for colds and asthma.

***Fouquieria splendens* (ocotillo, slimwood and coachwhip, mélhoki, ocotillo)**

Red blossoms mixed with water for a sweet drink. Children and adults recall collecting many in a bag and letting them drain and drinking the sweet nectar. Makes excellent firewood and its straight branches are used for living fences, which root in a few weeks and then produce green leaves shortly after rains. Was also used as to help structure adobe houses and to make ramadas. The fences are still commonly found at people's homes.

***Stenocereus thurberi* (organ pipe cactus, tcutcuis, pitahaya)**

The fruit is harvested and boiled to make syrup or wine or dried to eat later. This remains culturally salient to Mexicans, O'odham and the Anglos who still harvest its fruit shortly before the monsoon rains.

***Cerceilium microphyllum* (foothills palo verde, ko'okmadk, palo verde)**

The seed pods were crushed and eaten. This is no longer widely practiced.

***Opuntia engelmannii* (prickly pear, tuna, nohwi, nopal)**

Fruit harvested and boiled to make syrup or wine or dried to eat later. Its pads are also boiled and eaten or sliced a pickled. The pads and *nopalitos* (pickled slices prepared and canned) are still widely sold in stores in and around Ajo. A dressing can be made with fleshy pads to reduce pain/aid in healing cuts or the plant's pulp can be placed directly on the wound. Several people told me that eating too many fruits will give you chills or shivers. The pads are eaten or the boiled water is consumed in order to treat diabetes. It is thought by many to lower blood sugar.

***Carnegiea gigantea* (saguaro, giant cactus, sahuaro, ha:canyi, ha san, sahuaro)**

The fruit is harvested and boiled to make syrup or wine or dried to eat later. The fruit was collected and pulp removed and boiled to remove seeds and made into syrup for sweetening foods or fermented into wine over the course of four days. It was also common to make a sweet jam from the fruit to be eaten on tortillas. Its seeds were ground into a gruel to make a bread flour. Long wooden rib of dead saguaro used as tool to remove cactus fruits. The O'odham have many stories and myths that they are ancestors and thus have taboos about harming them.

***Phaseolus actuifolius* (tepary bean, bawi, teparia)**

Boiled and eaten or dried. Not as common as they once were. This bean was the preferred bean of the O'odham and is thought to be good for diabetes as well.

***Lycium* spp. (wolf berry, kohm, tomatillo,squaw berry)**

Eaten fresh or dried in the sun like raisins and then mashed in water to form a sweet beverage or combined in soups or stews. These are found in and along the *arroyos* in town. They are particularly spiny.

Animal Descriptions

***Calypte anna* (Anna's hummingbird, viik, colibri, chuparrosa)**

The most common hummingbird in the area and found year round. These are important pollinators for desert plants and are commonly found on feeders near homes.

***Ovis canadensis nelsoni* (big horn sheep, kahwul, borego, cimarrón)**

A rarely seen mountain sheep that has become an icon of the wild desert. Sightings are often reported in the mountains just north of town. It is still hunted in the area and on a lottery system on nearby public lands.

***Felis rufus* (bobcat, gevvho, gato montes)**

A cat with a bobbed tail smaller than a mountain lion. It is secretive but is sometimes seen in town especially during the hot dry months.

***Leptonycteris curasoae* (lesser long-nosed bat, nanakmor, murcielago)**

An important desert pollinator with a long tongue that it uses to eat nectar from the cactus flowers. The females raise their young in nursery caves and sometimes

abandoned mine shafts. Commonly seen in the Organ Pipe Cactus National Monument just south of town.

***Sylvilagus auduboni* (desert cottontail, to: pi, conejo)**

Abundant year-round in the desert they are still hunted and eaten. Domesticated rabbit can be found in the local grocery.

***Canis latrans* (coyote, bán, coyote)**

A desert omnivore the coyote is abundant in town and in the surrounding desert. Their 'yipping' is heard at night. They often roam the washes and alley ways at night looking for food or foraging in garbage. They are the main characters in many O'odham stories and is considered one of the first creatures ever created by their god *I'itoi*. Several mentioned taboos on killing a coyote.

***Antilocapra americana* (desert pronghorn, kuhwith, berrendo)**

Once abundant but now rarely seen the pronghorn lives in the desert outside of Ajo and in an enclosure in the nearby Cabeza Prieta Wildlife Refuge. Elders talk of seeing herds of them in the desert as children and that they would race beside cars and often win.

***Gopherus agassizii* (desert tortoise, komaktcï't, tortuga)**

Well adapted to the desert but now rarely seen. Many adults and elders relay stories of seeing many of the as children and commonly keeping them as pets. It is suggested by several people that they are no longer around because the desert receives less rain now than it used to. The tortoise too is an important character in O'odham stories. Mexicans sometimes eat the tortoise making a soup from its meat.

***Micrathene whitneyi* (elf owl, chukoch, tecolote, buho)**

Living in holes bored into cactus, this owl is tiny and rarely seen during daytime. Mexicans told me that when they see an owl it means bad luck and that someone you know will die soon. O'odham too have taboos about the owl, especially finding one dead.

***Callipepla gambelii* (Gambel quail, kakaitcu, codorniz de Gambel)**

One of the most commonly seen birds in the desert and known for their song. This bird is still widely hunted and eaten in local cooking by Anglos, Mexican and O'odham.

***Heloderma suspectum* (gila monster, cheadagi, monstruo de gila)**

One of the few poisonous lizards, the gila monster is known for it's remarkably bright coloration. They are considered 'dangerous' by children and adults alike and noted for their strong bite. I heard several stories about people who had been bitten by one that would not let go until you burned its tail.

***Phrynosoma spp.* (horned toad, chemamagi, cachorón, chameleon)**

A very common lizard rather than toad. Children keep these as pets. There is a myth that if you get too close they squirt red 'blood' from their eyes.

***Peccary angulatus* (collared peccary, javelina, kohji, cochi javelín)**

A notorious desert critter, the javelina is commonly seen, heard, and smelled (due to a musk gland on their neck) in town at night in the alleyways foraging for food. They travel in packs and are harmless unless provoked when they have reportedly charged at people. In Mexican, Anglo, and O'odham stories they are often a comical character. They are hunted and eaten by some. They must be prepared in a certain way to prevent the musk gland from contaminating the meat.

***Lepus californicus* (black-tailed jackrabbit, tcu'k tcu:wi, liebre)**

Commonly seen in the desert day or night. They are considerably larger than the cottontail and have giant ears that help to radiate heat off of their bodies. The O'odham have a word for a white-tailed jackrabbit and many people told me that there are both white and black tailed jackrabbits but I was unable to find the former. Some people eat them but they say the meat is not as tasty or tender as the cottontail. Tcu'k tcu:wi is the name of a Tohono O'odham village on the Mexico side of the border where there is a large spring.

***Felis concolor* (mountain lion, saimistar, león de la sierra, puma)**

The most feared and fierce of all Sonoran animals, the mountain lion is rarely seen. There are usually two or three sightings per year close to town. In cases where people have seen them, the experience is rarely forgotten. When people's animals turn up missing a mountain lion is usually suspected. There are many local myths that black mountain lions (or jaguars) exist and have been seen north of town, but this has not been corroborated.

***Zenaidura macroura* (mourning dove, hohhi, paloma triste, hiulota común)**

Known for its unique call 'who cooks for you' the mourning dove is commonly found in the desert and on feeders outside of homes. They can also be seen roosting high atop of the saguaro or organ pipe cactus. They are viewed by many as peaceful birds.

***Odocoileus virginianus* (white tail deer, a'ak, venado cola blanca)**

Differentiated from the mule deer by its smaller ears and stark white upright tail these deer are found in the desert and occasionally wander into town. They are hunted for

their meat, skin, and antlers. The O'odham still perform songs and dances shortly before hunting season begins.

***Corvus cryptoleucus* (raven, hawani, cuervo común)**

Found commonly in the desert, usually perched atop telephone poles in town or cactus. The raven is seen as a taboo for many and a messenger from the dead. They are usually seen in pairs.

***Geococcyx californianus* (road runner, tachai, correcaminos)**

An icon of the desert southwest they can be seen scooting quickly across or along the roadside. They are ground birds and rarely fly. Excellent hunters they are often seen with a snake or other small rodent animal in its mouth. Several Mexicans told me that they are sometimes killed and their tails are boiled to help cure the sick.

***Spermophilus tereticaudus* (round tailed ground squirrel, ci:ri'k, juancito)**

Found abundantly in the desert this ground squirrel is often mistaken for a chipmunk. Its body is well adapted for the desert, allowing it to conserve water and efficiently draw moisture from its food. These are comical creatures that are endearing to most people that I questioned.

***Centruroides sculpturatus* (bark scorpion, nakshel, alacrán, escorpión)**

Commonly found under rocks or wood this scorpion is poisonous and has a painful sting. People often wince in pain when they are mentioned and nearly everyone has a story of being stung. Children are warned of them at an early age.

***Scaphiopus couchi* (desert spadefoot toad, babath, sapo con espuelas)**

Living dormant underground, the emerge shortly after rain and their loud songs can be heard during monsoon season in the summer. Adults told me that they rarely hear

them anymore like they did when they were children and this is due to less rain and less water underground.

***Aphonopelma chalcodes* (tarantula, hiañ, tarantula)**

A large furry spider commonly seen in the desert or home. There are myths that they are poisonous and deadly if bitten but their poison is mild and they are not aggressive. Many children reported keeping them as pets. They are often characters in O'odham and Mexican stories.

***Cathartes aura* (turkey vulture, buzzard, nui, zopolote, aura común)**

Often seen circling the sky high above the desert or near dead animals or refuse. Large groups of them roost in trees near the Ajo town plaza. It is said by locals that when the snowbirds (meaning winter visitors) leave the vultures arrive from south were they spend their winters.

***Crotalus atrox* (western diamondback rattlesnake, nehbig, víbora de cascabel)**

Another dangerous animal in the desert the rattlesnake is feared by many. It is the reason why the O'odham would only sit on the ground and tell stories in winter, when the snakes are not around. Several people told me that hey hunted them and ate their meat which reportedly tasted like 'chicken'.

Planning for Interviews

Now, having chosen my referents, my second challenge was to determine how to obtain voucher specimens for the interviews. Previous ethnobotanical research has typically and successfully used plant trails in order to elicit names and information (Stross 1973, Zarger 2004). However, this would not work with animals because their

presence cannot be guaranteed on a plant trail, (nor would I want the presence of such desert animals as the rattlesnake or mountain lion to begin with!). Therefore, I needed to come up with an alternative to voucher specimens.

Previous researchers have experimented with using picture cards successfully for fish (Boster and Johnson 1989). However, one of the drawbacks of photo cards is that cards do not allow you to show movement or sound. Moreover, I wanted to keep my vouchers consistent across plants and animals, and researchers have documented multiple problems using photo cards for plants. Although visual stimuli that replace the actual plant or animal referent have been used often in ethnobiological studies, these substitutes are not without problems. One drawback of photos is their two-dimensionality. However, Johnson and Griffith (1998) point out that for large plants such as desert succulents, photos are often more practical than voucher specimens (e.g. the organ pipe cactus, *Stenocereus thurberi*, can reach heights of 23 feet, with branches averaging 6 inches in diameter). I began thinking about the possibility of using video but could not imagine how I would obtain the required video clips. However, the task of going out and collecting all of this video footage on my own certainly seemed daunting. And just then, I got lucky.

My friend Janet, whom I had met during my previous two field seasons and who works at the Organ Pipe Cactus National Monument had invited me to Mexico to visit her family's ranch which was located about 30 miles northeast of the border town of Sonoyta, Mexico. I immediately accepted the offer since I was excited to meet her family and to visit the ranch that had given Janet such wonderful childhood memories. Janet, like many people that I met in Ajo had a mixed cultural background of Mexican and

O'odham. Janet's grandmother was O'odham and her grandfather was Mexican. They had grown up as children on their grandparents ranch which sits just south of the now border that separates the Tohono O'odham Nation from Mexico. Her grandparents, ranchers by trade, had raised their own crops and regularly collected wild desert foods like cactus fruit. Janet has told me numerous stories about playing in the desert as a child and how she would pick baskets full of cactus fruit in the summer.

The morning of our trip I met Janet outside of the Organ Pipe Cactus National Monument office and she introduced me to Mike Foster, a friend of hers and videographer who would be joining us in order to film some of the plants at Janet's family ranch. As luck would have it, Mike had a hobby of collecting video of desert plants and animals and already had quite a collection of them on tape. As we talked throughout the day about my work and my ideas to conduct research possibly using plant and animal video clips I realized that my problem had been solved and then and there, Mike became an active member and contributor to my research project.

Over the next four months, we inventoried what video clips Mike had already, and what we would still need to find. In the end, all but a few of the animals were filmed live in their natural habitat with the exception of the desert pronghorn and mountain lion, which were filmed at the Cabeza Prieta fence enclosure and the Sonoran Desert Museum respectively. Once we had compiled all of the 45 video clips onto a DVD, we took the clips to several local experts in order to confirm the identification of the plant and animal species. These people were Vivian Sartori, National Park Service (NPS) Ranger and Dr. Lynelle Wagner, former NPS ranger and medical and herbal doctor. Once positive

confirmations were made of all of the species, we were ready to start planning for the interviews.

My next task was to make arrangements for the children's (student) interviews and determine where and how to complete them as well as contact parents and grandparents for the adult interviews. During the Summer of 2004, I had met Bob Dooley, the chair of the Ajo Unified School District and discussed my research plans and ideas with him. He had been very supportive of my work and had agreed to allow me to conduct my interviews at the school. Before arriving at my field site, I had written to the newly appointed principal of the school district, Don German who had also been supportive of my research project and who upon arriving at my field site, gave me additional help and assistance in setting up my project at that school.

In order to solicit participants, I made a presentation in August 2006 at the start of the school year to the student body of the Ajo Unified School District in order to explain the project. During my presentation, I described the research and what would be involved in the interviews. The presentation and information on the project was also written about in the local newspaper *The Ajo Corridor Times* and my name and number were provided for questions and additional information. During the school presentation, I showed some of the videos, which the students liked, and many of the them had questions regarding the purpose of the study and how the information would be used. As an incentive for participating, the teachers had suggested that all of the students who decided to participate would be able to go on a fieldtrip to the Organ Pipe Cactus National Monument. All students who were interested in participating and who returned their permission slips were included in the study. The field trip is detailed later in Chapter 6.

It was my original intent to select an equal number of elders, parents, and children, three cohorts of equal size in order to perform cross comparisons to determine inter-generational variations in knowledge. However, under the circumstances, this did not end up being possible for several reasons. Primarily this became impossible due to lack of parent and grandparent interest in participation. I attempted to contact parents to get them involved in several ways. First, through word of mouth and my contacts in the community and with several local institutions such as the Ajo Local Schools, library, Ajo Community Center and ISDA. Second, I made friends with the counselor at the Ajo Local School District who was an arm into the Native American community. She published a description of my research in her monthly newsletter with my contact information so that parents could call me with questions, concerns or in order to participate. Unfortunately, from that attempt I was never contacted by anyone.

In order to further request the participation of O'odham families, we also planned a parent meeting where I prepared a talk explaining my project, but none of the one-hundred or so O'odham parents were present. Several people that I spoke with informally explained that part of the reason for this is that many of the children's parents were having problems with substance abuse, incarceration, or were married or remarried and have left the children with a grandparent or another relative. Unfortunately, the longer I lived in Ajo, and the more informal conversations that I had with teachers, parents, and friends, it became clear that this had become a widespread problem in Ajo and on the O'odham reservation.

In taking another approach, I eventually sent the children's permission slips home, and asked for parents' contact information so that I would be able to call them

directly to request an interview. By making phone calls using the numbers listed on the papers, and enlisting the help of my research associate Irma Barajas, a local woman who knew many of the parents, I was able to secure 19 adult interviews. The remaining parents either had disconnected phone numbers, never returned my call, worked too much to make the time for an interview, or simply said that they were not interested in participating or had no interest in the subject. This time period became a learning experience in that it made me wonder, if they are not interested in the subject, how much this is affected what children know or learn?

My final step in the research design and preparation phase was to hire research associates to assist me with the interviews and to recruit additional participants among the adult and grandparent cohort. In order to complete the necessary number of interviews in the time that the school had allowed me to conduct my research, I would need three interviewers. From my previous pilot field work in 2004 I had met and maintained close contact with Tracy Taft, president of ISDA and Mimi Phillips, Director of Programs for ISDA. Their organization works to protect, educate, and conserve the cultural and natural resources of the Sonoran Desert and their work often involves many youths and families in the community of Ajo. Due to their tight connections to the community, I decided to start with them as a place to suggest a student or teenager to enlist as an interviewer. They suggested a few teenagers with whom they have had contact. One was Griselda Sandoval. I had met her mother, an O'odham woman who worked at the local grocery on many occasions and had even discussed my project with her. Griselda turned out to be an excellent interviewer because she was a peer to many of the students. Having a person who would be closer in age than I am to the students at the

school I felt would make them feel more comfortable during the interviews. Also, she grew up in Ajo, so they all know her and might tend to open up more around her.

Next, I selected Faye Miller. Faye was the mother of my friend John Wyatt, an informant who I had informally interviewed on several occasions and who was born and raised in Ajo. Faye was retired and very interested in the project. She knew almost all of the children in the study since she used to work at the school and knew not only their parents, but many of their grandparents too. Faye later became instrumental in helping me to setup several of the adult interviews. Next, as luck would have it in January of 2007 I moved houses in Ajo and becoming roommates with another anthropologist from the University of Arizona in Tucson named Jessica Piekielik who was in town studying the ecological repercussions of border crossings and patrol on public lands. Jessica worked as well as an interviewer on this project. Finally, I wanted to hire someone who was a native Spanish speaker and local who could help me to recruit Mexicans families into the study. My friend Irma Barajas, who I had met through her cousin Janet Castro, the Organ Pipe employee whose family ranch I visited, became my fourth associate and assisted me with Spanish translations and interviews with elders in the Mexican American community.

We conducted all student interviews at the Ajo Unified School District from September through November of 2006. All interviews were conducted in English or Spanish, depending upon the preference and language ability of the research participant. Because Spanish is prohibited to be spoken in the classroom (which is odd since approximately 60% of children in the school district are bilingual/native Spanish speakers) most children chose to speak English even though all of us are bilingual and

told them that they were free to speak either. In many cases, students used code switching back and forth from Spanish to English while speaking, especially for the names of certain plants such as the creosote—in Spanish *hediondilla.* This practice of seamlessly code switching between Spanish and English was very typical in Ajo since nearly 50% of the population is Spanish speaking. The students, most of them having grown up bilingual were masters at this practice.

Research Methods

Data collection methods included structured interviews, which involve asking the same questions in the same order to each participant, (Spradley 1979) consisting of free lists (Weller and Romney 1988), visual elicitation (Johnson and Griffith 1998), and participant observation in school and at key locations in the community following deMunck (1998).

The interviews included the following components: a free listing exercise, a recognition test, open ended questions about activities and behaviors, and demographic questions. I will now explain each component including why it was chosen, how it was collected, and for what purpose.

Structured Interview Schedule

Children's interviews took place at the school in one of two classrooms that were not being used. Each student sat with the interviewer at a desk equipped with a laptop or portable DVD player. All interviews were voice recorded using a small digital recorder. An interview data sheet was also used (Appendix C) in order to record responses and

notes by hand. The adult interviews were arranged over the phone and conducted at the home of the participant in much the same manner, using a laptop or DVD and taped and hand recorded. The duration of the interviews ranged from 30 to 60 minutes. The adults tended to speak longer and tell more narratives and personal experiences than did the children.

Free lists

Free lists are used in order to collect data on a particular cultural domain such as plants or animals. They are often used as a starting point in research in order to create a data collection tool, such as a survey or pile sorting exercise to be used later in one's study. However, they have also been used by researchers as a primary analytical tool as well (Fleisher and Harrington 1998) to answer a specific research question or to determine knowledge variation. I used free lists earlier in my project with experts to identify which plants and animals were most culturally salient in order to select my list of 45 referents that I would use during the video elicitation portion of my study. Now, I decided to use free lists in order to determine knowledge variation.

My purpose was to see if the lists of children would contain different types of plants and animals than those of adults. I expected the breadth of knowledge to be larger in the adult lists (containing a greater number of plant and animals) and to include a greater number of local or native items. I determined that collecting and analyzing these lists would allow me to delineate certain qualitative differences in plant and animal knowledge between children and adults, and would allow for direct comparisons based on list length, content, and breadth of knowledge. This analysis would help me to answer

my central research question of "Does ethnobiological knowledge vary based on learning contexts?" by comparing lists between generations and across the various methods of reported learning.

During the listing exercise, participants were asked a series of three questions: What are all of the animals that you know? What are all of the plants that you know? What are all of the wild desert foods that you know? Lists were solicited orally, recorded on paper, and later entered and saved as text documents.

Recognition Test

In order to further address what people know about plants and animals and how their knowledge varies, I employed a recognition exercise consisting of a series of short video clips of plants and animals. Videos worked well because they provided three-dimensional images and allowed participants to view the kinetic movement and sounds of animals during identification exercises. They also provided a focal point for discussion and often sparked stories about the plant or animal.

Figure 3.2 Griselda interviewing a student at the school.

The video clips were converted into an mpeg format and loaded onto a DVD portable disk. I used my laptop, as did Jessica, and I purchased two portable DVD players for Faye and Griselda to use during the interviews. At first, I was worried that although students would be familiar with technology and therefore comfortable with viewing video on the laptop or portable DVD players, members of the older generation would not be so comfortable with the technology. However, this was not a problem. In fact, I recall one interviewee, the 99 year old great Aunt of my research assistant Irma Barajas remarked, "I'm so glad that you brought these—I haven't seen these animals in so many years!" She was completely entertained and delighted while watching the clips.

The recognition and naming exercises served multiple purposes. It allowed me to quantify a certain type of knowledge, that being naming and recognition abilities. This would help me to determine both within group (all children) and between group (children and adults) variation. However, this exercise had additional purposes. It allowed me to differentiate between the most identified plants and animals and the least to identify items that are no longer recognized by the younger generation. This would provide me with data to answer my question about how knowledge varies by identifying species that this generation of children did not recognize. Finally, the videos sparked conversations about the plants and animals including where they have seen it, how they learned about it, and cultural information such as uses, and narratives.

During the recognition exercise, we showed the plant videos first to 50% of the participants and the animals videos first to the other 50% in order to diminish any biases that might affect the reliability of the interview procedure. The interviewer played each video clip one at a time for the full duration of 20 seconds and then asked "Do you know

the name for that plant or animal?" "Do you know any other names?" Where/when have you seen this? Several informal prompts were added in order to encourage responses. Often times, the participant began answering before the video segement had fully played or spoke throughout its duration.

Open Ended Questions

Open-ended questions were given after the video recognition exercise and involved social interactions, hobbies, and learning. Lastly, participants were asked to report on demographic information including age, gender, years of residence, and languages spoken. This is usually saved for the end because it posited that by then, the interviewee is more comfortable with you and therefore more willing to answer these questions (Spradley 1979). The questions concerning social interactions, learning, and hobbies applies to the overall question "Does ethnobiological knowledge vary based on learning contexts?" by identifying variation regarding not only *what* is known but *how* knowledge is acquired. The demographic data provided me with a means to explain within group variation based on ethnicity, age, gender and residence.

Informal Interviews and Participant Observation

Since certain types of sociocultural events and interactions are best described and documented through observation (deMunck 1998), additional data on inter-generational interactions and activities were collected through ongoing participant observation and opportunistic observation at community locations including: Volunteer projects at the Curley School, the Ajo Unified School District, field trips at nearby parks, and at the homes of present contacts in the community.

Figure 3.3 One of the locations where I made weekly observations was the Ajo Community Center, a facility that included an outdoor park and playing fields, a swimming pool opened seasonally, and an indoor meeting area and educational facility.

I recorded notes and photographs about observations, behaviors, and conversations on a daily basis and reduced and coded these into descriptive categories following Miles and Huberman (1984) before leaving my field site in April 2007. This observational and ethnographic data added context to the research by providing information about the educational opportunities available, the types of interactions that children have with elders, and rich ethnographic detail on the community practices that are used to convey ecological knowledge. Keeping detailed field notes of my observation and participation in community practices helped me to explore what exactly accounts for changes in learning and whether the reasons for knowledge variation are due to acculturation or a divergence from a more traditional lifestyle or whether there is a lack of interest or lack of opportunities for nature exposure.

Conclusion

In this chapter I have presented my overall research design and methods following theory on processual qualities of ecological knowledge. The chapter provides an ethnographic account of the research preparations including deciding upon the plant and animal referents and the hiring of project staff. Methods used during data collection are free listing, a recognition test, and open ended structured questions.

In Chapter Four, I will present the findings from children and adult cohorts and then compare the two cohorts in order to identify knowledge variation between the two generations. The evidence presented in this chapter will include data from free lists and recognition test scores and will be supplemented by qualitative data from interviews and my own observations and ethnographic field notes.

Chapter 4

Inter and Intra-Generational Variation of Ethnobiological Knowledge

"When I was Small"

When I was small I lived in Chui-Chui.
When I was small I went to school.
When I was small I chewed on mesquite beans.
When I was small I picked dry sap.
When I was small I picked greasewood.
And now the children don't do this any more.
Nellie Miguel

Figure 4.1 A lesser-long nosed bat, an endangered species found in the Sonoran Desert is vital to the survival of the columnar cacti as they are one of its primary pollinators, doing their work during nighttime hours. (reprinted with permission from Bat Conservation International)

As often happens in one's fieldwork, by the time that you have been at your site for six months or so and performed numerous formal and informal interviews, you have

had to explain what you are doing there dozens of times. This entails being able to give a quick synopsis of your dissertation in three sentences or less (from personal experience I found that any more time will render the asker bored as can be and plotting an escape plan). In a typical situation, I would walk up to someone, introduce myself, and state, "I'm here in Ajo doing a study on what children today know about the Sonoran Desert". Nine times out of ten I would get the response, 'Oh, that's easy. I can tell you right now that they know nothing!' By about the fifth or sixth time that I received this response, I started to wonder what kind of effect this has on what children know. If their parents or grandparents, or in fact the whole generation has already given up on them, then what is their motivation to learn? And furthermore, is the older generation even trying to teach them anymore? Researchers have identified a number of factors that may contribute to loss and / or changes in nature knowledge including loss of motivation, changes in exposure, employment, attitudes of older generations, social breakdown of extended families, and environmental changes (Heckler 2002, Krech 2005, Ross 2002, Zent 2001).

One of the phenomenon occurring in today's modern society is a loss of contact with nature leading to a loss of intimate knowledge or familiarity with the outdoors (Nabhan and St. Antoine, Louv 2005). Journalist Richard Louv's popular book, *Last Child in the Woods* focuses on children's loss of contact with the natural world. Some of the statistics that he quotes in his book are staggering. For example, only six percent of American children play outdoors on their own in a typical week. He recalls interviewing a child that stated "well, I like to play indoors better because that's where all of the electrical outlets are". Many of the students who we interviewed named indoor activities such as watching television or listening to music. From my own experience spending

time at the Ajo school, students were “plugged in” to electronic devices during their free time between classes, talking on cell phones or listening to their mp3 players. While spending time in family homes, television was generally the central focus of the living spaces. Every home that I visited in Ajo had at least one television and for a rural area, it is surprising the number of options that exist for cable and direct television service. regarding television and her time spent watching it, one woman commented to me, ‘well, we’re out here in the middle of the desert so it’s our one connection to the outside world’.

Children’s knowledge of plants and animals are also affected by their motivations to learn about them. Socio-cultural changes such as an increased access to media influence what children do during their free time. For instance, today watching television is one of the most popular activities among children. It is then no surprise that researchers have found that children are better able to name more brands of cola or cartoon characters than types of plants or animals.

In some cases, knowledge is lost due to lack of access to natural areas or shifting priorities that make other kinds of knowledge more critical in an urban environment. For example, Nabhan and Trimble refer to a PBS broadcast that aired shortly after the riots in Los Angeles in the early 1990’s. One adolescent who was interviewed was able to name over half a dozen automatic weapons and identify them by their sounds (Nabhan and Trimble 1994). Indeed, in an urban area such as south central Los Angeles, it would be more important to identify gun shots than to identify the call of a bird or the footprint of a mammal. As children become less familiar with their natural surroundings, information such as the names of creatures, the uses for particular plants, or the behavior of animals becomes less relevant, leading to a loss of nature knowledge. In Ajo, given its remote

desert location, lack of access to nature does not appear to be a problem. What seems to be more influential is that priorities have shifted in younger generations. When talking to students, I often asked them what they wanted to do after they graduate. They would comment 'get out here' or 'go to Phoenix' or another urban area to work in a store or a business. When I asked why, they said 'that is where all of the jobs are; you can make money there'. There is indeed a perception that in order to make money, one needs to go to an urban area to work indoors.

To date, little comparative research has been conducted that examines children's loss of intimate contact with the natural world and how this will impact what children know about nature or the motivation to be good stewards of the environment. In Chapter Three, I described some of the social and ecological changes that have occurred in the Sonoran Desert region and provided demographic and ethnographic detail of the field site in Ajo, Arizona. In this chapter, I will begin to address my overall research question, Does ethnobiological knowledge vary based on learning contexts? by focusing on identifying what is known about desert plants and animals among two cohorts: children and adults. Focal questions are: Which plants and animals are more named and recognized? Do participants know species specific names or only generic names? Are non-native plants favored over native plants? Do participants who know more about plants and animals have certain demographic characteristics that others do not? What plants and animals are no longer named or recognized by the younger generation? In this chapter I will present the findings from each cohort and then compare the two cohorts in order to identify knowledge variation between the two generations. The evidence presented in this chapter will include data from free lists and recognition test scores and

will be supplemented by qualitative data from interviews and my own observations from living in the community.

Knowledge Change in Younger Generations

An increasingly researched topic in the literature on cultural transmission is loss of knowledge and skills in younger generations, particularly environmental knowledge. The loss of TEK, especially among younger generations, has been the focus of numerous ethnobiological studies (Heckler 2002, Ross 2002, Zarger and Stepp 2004, Zent 2000). Heckler (2002) and Zent (2001) have attributed ethnobotanical knowledge loss among the Piaroa of Venezuela to acculturation and changes in cultural values. Ross (2002) found marked differences in ecological knowledge among the Lacandon Maya between children and elders with both exhibiting significantly different environmental models.

Hunn (2002) and Nabhan (1994) both explore the phenomenon of environmental knowledge devolution that occurs when children growing up today have less intimate contact with the natural world. Hunn questions whether acquisition deprivation of natural environment knowledge is long lasting in the same way as language deprivation is in children of young ages. Nabhan also questions whether children's lack of contact with the natural world fails to activate an innate biophylia or innate natural curiosity for the natural world.

Development, such as market integration or a shift from foraging to wage labor, is thought to be one of the driving factors behind loss of TEK since it often involves widespread social and cultural changes. However, research in this area thus far has demonstrated mixed results, with development driving a loss of knowledge in some

cases, and persistence of knowledge in others (see Godoy et al. 1997, 1998, Guest 2002, Reyes-Garcia et al. 2005, Ross 2002, and Zarger and Stepp 2004). Guest (2002) found that market integration did not necessarily cause ecological knowledge loss in coastal Ecuador. On the contrary, new knowledge seems to be emerging due to people's participation in newly developed post-larva fishing practices, which has actually increased their exposure to the natural environment. Godoy et. al (1998) found that market integration among the Tawahka Indians of Honduras has different effects on knowledge depending on the market. Agriculture and wage labor was associated with less knowledge and the sale of timber/non timber forest products with more. However, Toledo (2002) has criticized such quantitative approaches since they often do not unravel the complex relationships of changes that take place as a result of development and modernization, nor do they allow for perspectives on human agency in these processes, but rather name locals as the mere victims of outside intervening powers.

Ohmagari and Berkes (1997) discuss the changes in the nature of the transmission process in Western James Bay Cree of Subarctic Canada and identify problems and factors that tend to impede transmission. They attribute the loss of skills in younger generations to environmental changes, diminished time in the bush, problems related to learning at later ages, and changes in value systems. Some of the specific value changes are a loss of contact between children and elders and an undervaluing of elder's knowledge. As exemplified in the opening vignette, a negative perception of the younger generation tends to perpetuate itself, starting a cycle of negativity that is hard to break. For example, children are not interested, maybe because they lack experiences or exposure to the outdoors. Then parents say, 'why try because they aren't interested

anyway?' and so, the kids never learn, and furthermore, parents too forget cultural information linked to local plants and animals because they are no longer passing it on. This cycle eventually leads to a decrease in overall knowledge across all generations.

The advent of formal schooling and television has also been blamed for loss of skills. Nabhan and St. Antoine (1993) found a marked loss of environmental knowledge among children in rural Arizona as compared to their grandparents. Most children reported gaining most knowledge of animals vicariously through television or videos rather than through first hand experiences. When this shift in transmission occurs, children often learn non local animals such as pandas, tigers, or other flagship species rather than local ones. Indeed, many of the participants in the children's cohort named exotic animals that they had seen on the Discovery Channel or on shows such as the *Crocodile Hunter*.

Researchers have noted that loss of native language, in particular folk species names, has had a profound effect on ecological knowledge (Hill 2003). Hill's findings indicate that when species names are lost, ecological knowledge is also lost since both ecological and cultural information are often included in folk names for species. Zent (2001) also addresses the importance of names in his study with the Piaroa of Venezuela. He found that naming ability is a significant positive predictor of correct knowledge of use categories for the plants in his study.

Few of the O'odham children who participated in the study spoke any of their native language. Surprisingly, many of the Mexican children who reported growing up in a bilingual household with Spanish as their first language only knew the English names for plants and animals. This may be an indicator that children are learning about plants

and animals primarily at school (where all instruction is done in English) or on television. If they had been learning through family members, it seems that they may have been more likely to have known the Spanish names.

Finally, changes in social interactions have also been linked to knowledge loss. Both Ohmagari and Berkes in their work with the James Bay Cree and in Norbert Ross' work with the Lacandon Maya have cited loss of contact between generations as a reason for changes in the cultural transmission and ultimately, a loss of ecological knowledge. Research has demonstrated that cultural transmission often occurs during informal learning experiences with family members that take place during the rituals of everyday community practices and social interactions (Cajete 1992, Chipeniuk 1995, Hewlet and Cavalli-Sforza 1986, Ohmagari and Berkes, Ruddle 1993, Wyndham 2002, Zarger 2002). Ecological knowledge about plants and animals is learned through interaction with others who are more knowledgeable. One of the reasons that I was unable to conduct more adult interviews was that it was very difficult to find times when parents were home. Many of the adults in Ajo both work, or work two jobs, one during the week and another on the weekend. This leaves little time for children to spend with adults since they spend the bulk of their week in school and in after school activities such as sports or hanging out with friends. During my observations at local parks and community centers I rarely saw children and parents involved in activities together, the exception being attending church on Sundays or during holiday celebrations.

Qualitative Differences in Knowledge

Researchers have differentiated between two types of ecological knowledge. One labeled declarative (Wolcott 1997) or theoretical (Godoy 2006) or intellectual (Atran 2002) knowledge involves the ability to name or recognize referents. The other referred to as procedural or practical knowledge involves skills and abilities such as how to cultivate or cook a plant (Toledo 2002). Reyes-Garcia et al. (in prep) has compiled all of the ecological knowledge studies that have been conducted in the anthropological, biological, and economic sciences between 1986 and 2005 and determined that only eight of the 46 studies that were identified included measures of both theoretical and procedural knowledge. This dissertation includes data on declarative knowledge via free lists and a structured questionnaire that tested recognition abilities, and procedural knowledge using open ended questions to determine if participants comment about uses or ecological information for each referent.

Declarative and procedural knowledge, although theoretically separate, often inform one another. For example, declarative knowledge such as naming abilities can often impart cultural knowledge about a particular referent. Hill's (2003) study among the Tohono O'odham found that names mediate rapid access to cultural and personal knowledge. During interviews I noted that many children did not recognize the creosote bush. However, when I would tell them it is the hediondilla or it's the raintree, a look of recognition would sweep over their face and they would often make a statement such as 'Oh, yes, I know that one! It's the one that makes the desert smell so good!"

Nabhan (2002) also discusses how the Tohono O'odham and the Seri, who have lived in the same habitats for centuries encode cultural and ecological information about

interactions between species into language. In looking at specific versus generic names for plants and animals (e.g. roadrunner versus bird), Berlin (1992) notes that when knowledge begins to fall off, the more specific names are lost first. As specific names for plants and animals erode, so to does too does some practical knowledge. Therefore, referring back to my question of what children know and how knowledge varies, I differentiate between generic and specific names for plants and animals in order to identify patterned knowledge and variation among the study participants.

Characteristics of Plants and Animals

Researchers have questioned whether there are particular characteristics of plants and animals which make them more memorable. Berlin (1992) and Atran (1987) have postulated that people know more about species that are easy to observe, large, social, colorful, abundant, noisy and diurnal. Others explain certain animals' salience in American society by postulating that potential danger and emotional meaning are significant factors (Kellert 1989, Nolan 2006). Frequently, while interviewing students, my research assistants and I noted that they would shriek or recoil as they watched the video of a tarantula or a diamond back rattlesnake. During my conversations with locals, I heard time and time again that, 'everything in the desert bites back' referring to sharp cacti and the numerous snake and scorpion species that will sting or bite you. So in this regard, I would postulate that species such as the cholla cactus, rattlesnake, and bark scorpion and other dangerous plants and animals of the Sonoran Desert would be culturally salient and therefore more often named and recognized than others.

Characteristics of People

Researchers too have been interested in identifying whether certain demographic or behavioral characteristics explain knowledge variation. For example, Krech (2004) states that ecological knowledge varies by age, gender, family history, occupation, level of involvement in curing or ritual, degree of exposure, commitment to indigenous culture, interest, and curiosity. In order to address variables that may explain patterned variation, this dissertation includes an analysis of certain demographic and behavioral characteristics in relation to knowledge. The recognition scores will be cross analyzed with demographic characteristics in this chapter, and with behavioral characteristics such as learning and free time activities in Chapter Five in order to determine if variation can be explained by these factors.

Research Population

The younger cohort (n = 110) who participated in this study were a tri-cultural ethnic group of Anglo (44%), Mexican (53%), and Tohono O'odham (13%) students from the Ajo local school. Thirty-four percent of the students speak only English, 60% speak English and Spanish, and 6% speak English, Spanish, and Tohono O'odham. Only one participant cited Tohono O'odham as their first language learned. The participants are 66% male and 44% female and their age range is from 12 to 20 years old with the mean age of 15 years. On average, the participants have lived in Ajo or one of the nearby towns on the Tohono O'odham reservation for 11 years. Seventy-eight percent of the participants reported living "in town" while 22% reported living outside of town on a ranch or remote part of the desert. All student interviews for reasons of consent were

conducted at the Ajo Unified School District although many of the students live on the Tohono O'odham Reservation or in the nearby border town of Lukeville and attend school in Ajo. In fact, informal conversations with students and parents revealed that some students had a daily commute of nearly an hour every morning to arrive from the reservation or from Mexico at the Ajo school.

The adult and elder cohort (n = 19) who participated in this study were a tri-cultural ethnic group of Anglo (26 %), Mexican (53 %), and Tohono O'odham (21%). Twenty one percent of the adults speak only English, 58% speak English and Spanish and 21% speak English, Spanish and Tohono O'odham. Only one participant cited Tohono O'odham as their first language learned. The participants are 16% male and 84% female and their age range is from 31 to 99 years old with the mean age of 53 years. On average, the participants have lived in Ajo or one of the nearby towns on the Tohono O'odham reservation for 42 years. Ninety percent of the participants reported living "in town" while only 10% reported living outside of town on a ranch or remote part of the desert. All adult cohort participants were interviewed either in their homes or at a community location such as the library.

Variation in Lists of Plants, Animals, and Wild Foods

Free lists of plants, animals, and wild foods were analyzed using Anthropac software which combines all of the participant's lists and calculates frequencies and ranks for each item. Anthropac also calculates a salience score which is a combination of the item's frequency (how often it appears on a list) and its rank (where it appears on the list). Due to multiple common names for plants and animals and respondents answering

in Spanish, English or Tohono O'odham, the free lists analysis was completed with uncoded lists in Anthropac, and then recoded into one category based on the participant's most frequently named emic word for the plant or animal. This coding scheme was done in order to include multiple names for one referent such as Desert tortoise and tortoise or greasewood, creosote, raintree, and hediondilla (all common names for *Larrea tridentata*) into one category.

When coding or standardizing responses it is easy to make the mistake of using the notions and biases of the researcher in doing so. Weller and Romney (1988) suggest seeking the aid of informants to maintain an emic perspective. A random group of informants were consulted when reducing the free lists in order to ensure accuracy in collapsing names into one category. Specific names such as roadrunner were not collapsed into broader life form categories such as bird but kept separate in order to differentiate between generic and specific names. Due to the high level of variation in the lists, a cutoff point where frequencies began to drop off was used. This technique has been suggested by Weller and Romney (1988) in cases when lists contain a large number of items on items with low frequencies.

Free List Results

Children's animal lists (see Table 4.1) included 178 unique items with an average list length of 12. Plant lists included 85 unique items with an average list length of 5, and wild food list included 42 items with an average length of 3. Children named a greater number of animals than plants and wild foods. Non native items made up 45% of their animal lists, 58% of the plant lists and 12% of the wild foods lists. Eleven percent of the

plant list were generic names (e.g. tree), 4% of the animal list (e.g. bug) and 40% of the wild foods list (e.g. flower).

Adult animal lists (see Table 4.2) included 174 unique items with an average list length of 21. Plant lists included 115 unique items with an average list length of 11, and wild food list included 67 unique items with an average length of 7. Adults named a greater number of animals than plants and wild foods. Non native items made up 9% of their animal lists, 17% of the plant lists and 6% of the wild foods lists. Two percent of the plant list were generic names, 1% of the animal list, and 6% of the wild foods list.

Table 4.1 Children's Free Lists of Animals, Plants, and Wild Foods

Animal	Frequency	Rank	Saliency (Smith's S)
mountain lion	33	7	0.415
dog	28	5	0.421
cat	28	5	0.407
snake	23	5	0.290
bird	19	6	0.225
lizard	17	8	0.176
coyote	17	5	0.245
tiger	15	11	0.137
bobcat	13	3	0.221
deer	13	10	0.142
javelina	11	10	0.124
rabbit	10	7	0.128
rattlesnake	10	8	0.119
rat	10	9	0.107

Plant	Frequency	Rank	Saliency (Smith's S)
cactus	20	2	0.309
saguaro	19	3	0.280
rose	15	3	0.184
palo verde	15	3	0.204
mesquite	10	4	0.124
ocotillo	8	4	0.101
cholla	8	4	0.095
flower	8	4	0.091
tree	8	2	0.143

Wild Food	Frequency	Rank	Saliency (Smith's S)
cactus fruit	36	2	0.643
cactus	10	1	0.183
snake	10	3	0.12
rabbit	9	3	0.108
prickly pear	8	2	0.105

Table 4.2 Adult Free Lists of animals, Plants, and Wild foods

Animal	Frequency	Rank	Saliency (Smith's S)
mountain lion	12	10	0.511
deer	9	12	0.373
javelina	9	7	0.363
tortoise	9	15	0.229
coyote	7	7	0.328
rattlesnake	7	9	0.294
bobcat	7	10	0.282
Plant	**Frequency**	**Rank**	**Saliency (Smith's S)**
palo verde	10	6	0.425
saguaro	9	4	0.433
mesquite	9	7	0.337
ocotillo	6	5	0.246
ironwood	5	5	0.197
cholla	5	7	0.156
Wild Food	**Frequency**	**Rank**	**Saliency (Smith's S)**
nopal	10	3	0.344
tunas	8	4	0.298
rabbit	5	5	0.177
mesquite beans	5	5	0.138
catus fruit	4	5	0.144
javelina	4	6	0.145
pitaya	4	2	0.204
quail	4	10	0.086

Free List Discussion

The major findings of the free lists are one, that there are similarities in salience of animals and plants between the children's and adult lists. Differences between the two cohorts are primarily in the list composition. Children's lists are more general and contain a greater number of generic names while adult lists are more specific and contain species specific names. Children's lists tend to contain a greater number of non native species than adult lists. The greatest inter-generational differences occur when comparing

children and adult wild foods lists. Adults have a much greater specificity and breadth of knowledge when it comes to desert wild foods.

In looking at similarities in salience of animals and plants between the children's and adult lists, several patterns arise. First, both cohort's lists contain animals that could be considered dangerous to humans. The mountain lion, most salient for both cohorts, rattlesnake, and bobcat are considered salient for children and adults. Researchers have examined this phenomenon and hypothesized that there are still many evolutionary characteristics for why particular animals are feared and perhaps more salient in the human psyche (Nolan et al. 2001) Evolutionary psychologists and sociobiologists have hypothesized this to be an evolutionary adaptation passed on from our early ancestors who had to avoid these animals in the wild in order to survive. Therefore, there apparent salience may not be due to informal learning experiences, but rather to parental warnings and/or biological reactions driven primarily by fear. Time and time again during interviews, children said, 'Oh, that's a scorpion; my mother always tells me not to run barefoot in the summer because I'll step on one'. Adults too spoke of animals that they were warned about as children. Some of the most explicit stories that I heard during interviews were stories about encounters with these dangerous animals. Many participants had been stung by a scorpion and almost everyone had their favorite rattlesnake sighting to share with me. Fear sometimes drives senseless killing of animals such as the rattlesnake, who play an important role in the desert ecosystem.

Figure 4.2 A rattlesnake that had been killed with apparently a shovel to the head, found dead along a back road in Ajo.

During interviews, children often described a father or other relative killing a rattlesnake that was crossing the road or found in their yard. Informal conversations revealed that there are cultural taboos against rattlesnakes, seen as bad luck. The fear about rattlesnakes is real in Ajo. Rattlesnakes when close to the home are a danger to people and pets. During my stay in Ajo, the newspaper reported on two separate rattlesnake bites costing the victims thousands of dollars to pay for the anti-venom treatment.

The mountain lion, the most frequently named animal on their free lists, is one of the most fierce animals in the Sonoran Desert. Much urban folklore exists in Ajo concerning this animal and local sightings. During my time in Ajo, a mountain lion was spotted twice in town and reported on the front page of the local newspaper *The Copper News*. Locals recall that about every year or so, mountain lions are sighted in town or in

the desert surrounding the outskirts of town. Many people warned that when small pets such as cats and dogs are missing it is because a mountain lion has come down from the mountains surrounding Ajo to look for food or water. Mountain lions are mostly reported being seen in the summer months when food and water are scarce.

The most frequently named plants on both children's (Table 4.1) and adult lists (Table 4.2) are some of the largest on the landscape. The salience of trees such as the palo verde and the mesquite and the saguaro which can grow to heights of 20 feet tall are some of the largest and the most prevalent vegetation in the desert. All three of these species can be found growing in neighborhoods around town as well as in the natural desert. Familiarity and size could explain the salience of these plants.

The most prominent differences between the two cohorts are in the list composition. Children's lists of plants, animals, and foods are more general and contain a greater number of generic and life form names (see Appendix B for Tables 4.3 and 4.4). For example, snake, bird, and lizard from children's animal lists, cactus, flower, and tree from their plant lists, and cactus fruit and cactus from the foods lists. Adult lists are more specific and contain species names such as rattlesnake, palo verde, and *nopal* (prickly pear cactus pads). This follows the findings by Berlin (1992) and Atran (2001) that specific names are lost before generic names. Another finding is that children's lists contain a greater number of non native species than adult lists. Dog, cat, tiger, and rose were some of the most salient items on children's lists while adult lists included a higher percentage of Sonoran native species.

The greatest inter-generational differences occur when comparing children and adult wild foods lists (Table 4.1 and 4.2). Adults have a much greater specificity and

breadth of knowledge when it comes to desert wild foods. Adult lists were longer (67 versus 42 unique items) and contained 94% specific names versus 60% specific names on the children's lists. The children's wild foods lists contain the least number of items and variation of all of the lists. This is not surprising given the conveniences of modern society, even in rural Ajo, making it unnecessary to forage for wild foods. During the course of the interviews, I asked one of the students what they would eat if stranded in the desert, and he replied, "Why I'd have plenty to eat because I'd just bring food with me from the Circle K!" During interviews, adults reported many experiences harvesting wild desert foods as children, and some still harvest as adults.

Figure 4.3 Cactus fruit from the saguaro that I harvested while on a community trip to OPNM. Using the traditional method of harvesting, this bucket took me two hours to collect having had difficulty polishing my technique of knocking the fruit off of the top of the saguaro and positioning the bucket in order to catch it before it fell to the ground.

Cactus fruits and cactus pads were prominent on both children's and adult's lists. Cactus such as the saguaro, organ pipe, and prickly pear produce fruit starting in mid-July just at the onset of the monsoon rains and it is still common practice for all three ethnic groups to harvest the fruit as the Tohono O'odham once did. Cactus and prickly pear are still commonly eaten and the pads of the prickly pear cactus, called *nopal* or *nopalitos* in Spanish are sold at the local market.

Figure 4.4 The inside of the saguaro fruit showing the sweet flesh of the fruit and the small black seeds, both of which are eaten.

Foods such as snakes and rabbits were also found on both cohort's lists. These foods have traditionally been a food in the desert southwest. During my first shopping trip to the one and only small market in Ajo, I was surprised to see packaged rabbit for sale in the meat section. Snakes are more rarely eaten although several children discussed having seen a parent or grandparent kill a rattlesnake, skin it and prepare the meat. Several children had eaten the meat as well commenting that it tastes rather like chewy chicken. Once again, familiarity and experience account for the named wild foods. Some

of the foods that were named less frequently by children, but named frequently by adults such as the mesquite bean pods were once a staple diet for the Tohono O'odham and Mexicans who ground the flour and used it to make breads and a sweet nourishing drink called *pinole*. Only three of the 110 children even named this as a food source even though mesquite trees and their pods are particularly abundant in and around Ajo.

Variation in Recognition Ability

Some earlier research on cultural knowledge did not address intracultural variation but rather focused on describing knowledge systems, often treating them as static, assuming that knowledge was widely shared among members of the community. This work sometimes relied on a couple of expert informants who were thought to hold representative knowledge for the entire community. While this method was useful in the sense that it is able to provide us with a synchronic picture of knowledge, it did not allow for a view of variation, change, or distribution. More recently, researchers have focused on intracultural variation of knowledge in order to identify patterns of knowledge distribution. There is a growing number of studies that use quantitative and/or systematic methods to discover intra and inter-cultural patterned differences in ecological knowledge (see Atran et al. 2002, Boster 1986, Casagrande 2004, Godoy et al. 1998, Reyes-Garcia et al. 2005, Zent 2001). Berlin (1992) notes that while informants will differ in their responses to stimuli presented to them in natural or artificial ethnographic contexts, their responses "will show a patterned distribution that will allow the investigator to infer some underlying structure(s)" (p. 200). Therefore, the patterns that emerge in the

recognition data apply to the sub question: Do participants who know more about plants and animals have demographic characteristics that others do not?

Data from the recognition exercise, open ended questions, and demographic questions were entered into SPSS software to calculate frequencies and averages, and to tabulate results by demographic and behavioral information. Each plant and animal referent was entered into the database with a single unique code for each respondent. The data was then transcribed from the interview sheets into the database. Each taped interview was marked with the same code as well in order to link them together. The interviews were downloaded from digital recorders into voice editing software and saved on my computer's hard drive. The SPSS data was coded a 0 if the respondent did not know the name of a referent and a 1 if they knew the generic name such as tree or bird and a 2 if they knew the specific name such organ pipe cactus. Frequency analysis was then run using the *Descriptives* command to obtain an overall mean score based on this coding scheme. Thus, the higher the score, the greater and more precise recognition ability of the respondent.

Frequencies were also computed for each animal referent in order to determine the most and least recognized plants and animals. Using the *Split File* command, the data was divided by ethnicity, gender, age, years in region, location of home, and grandparent in home and frequencies were computed for each recognition score to search for patterns of variation.

Means and Group Comparisons

The results of the recognition test for both cohorts are shown along with demographic data in Appendix B Table 4.5. The mean score for recognition using specific names was higher for adults (31 vs.17.5) out of a possible 45 points. The range of scores was from 22 to 40 for adults and 2 to 32 for children. Mean score correlations were computed using a ANOVA analysis of variance test with the demographic variables age, ethnicity, gender, household (in town versus out of town), and grandparent (Do you live with a grandparent?), and languages spoken. Scores are reported as significant at the following levels: .01, .05, and .10. The analysis revealed that for children, the knowledge scores correlated at the .01 level for participant's age ($f = 2.943$, $p = .011$) but not for the adults ($f = .724$, $p = .706$). Ethnicity was significant for adults ($f = 3.113$, $p = .072$) but not for children ($f = .250$, $p = .779$). Gender was not significant for children ($f = .277$ $p = .599$) or adults ($f = 1.463$, $p = .243$) Location of home for children was significant at the .10 level ($f = 3.275$ $p = .073$) but this was not calculated for adults because only1 adult lived outside of town. Living with a grandparent (for children, if they currently live with a grandparent, for adults if they did as children) was not significant for children ($f = 2.042$ $p = .156$) or adults ($f = 1.275$ $p = .274$). Languages spoken was not significant for children ($f = .175$ $p = .950$) or adults ($f = 1.734$ $p = .199$).

Frequency Distributions

Overall frequencies for plant recognition (Appendix B Table 4.3) and animal recognition (Appendix B Table 4.4) are listed for the number of respondents who were able to correctly identify the plant or animal referent with a specific versus generic

names. The distribution of species level names for plants (Table 4.5) and animals (Table 4.6) show differences between the children and adult cohort. Recognition scores were higher for animals than they were for plants but a paired t test did not show a significant difference in the mean scores between plants and animals at the 95% confidence level. Most recognized animals for children were tarantula, scorpion, road runner, and javelina. Least recognized were lesser long-nosed bat, spadefoot toad, elf owl, and pronghorn. Most recognized plants for children were saguaro, prickly pear, organ pipe cactus, and palo verde. Least recognized plants were Mormon tea, beargrass, jojoba, tepary bean, and sacred datura.

Most recognized animals for adults were scorpion, tarantula, and roadrunner. Least recognized animals were the elf owl, spadefoot toad, and lesser long-nosed bat. Most recognized plants for adults were palo verde, prickly pear, saguaro and creosote. Least recognized plants for adults were mormon tea, tepary bean, sacred datura, brittlebush, and beargrass.

Table 4.5 Frequency distribution of species specific names for plants for the children's and adult cohorts.

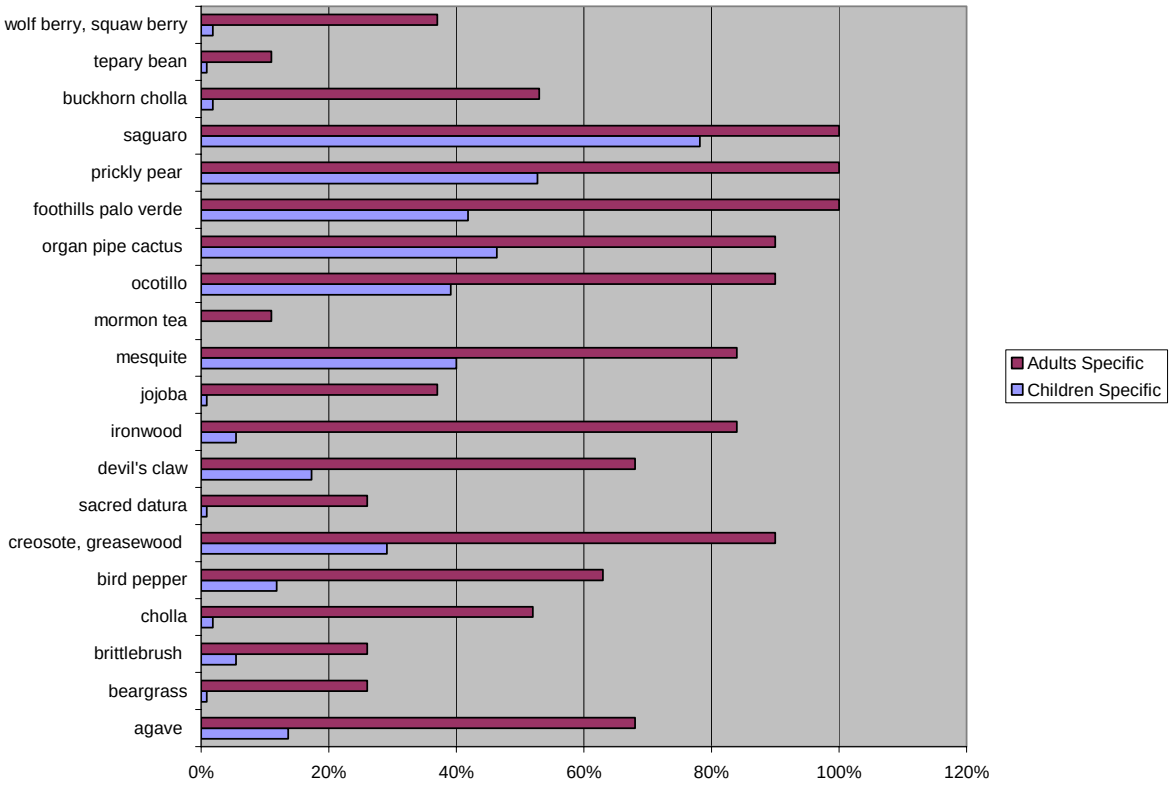
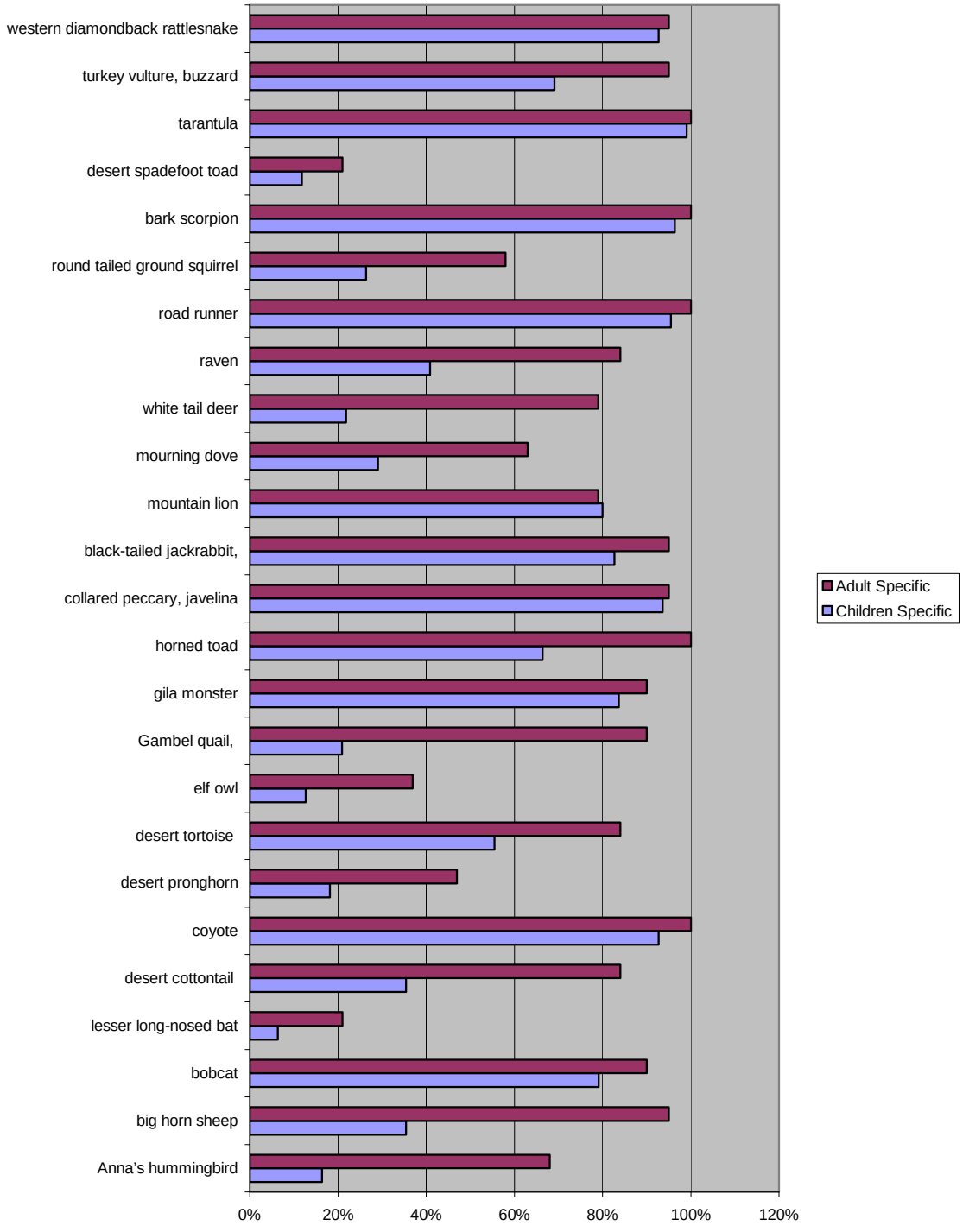


Table 4.6 Frequency distribution of species specific names for animals for the children's and adult cohorts.



Discussion

The following are the major findings of the recognition analysis. Adult recognition scores were higher than children's scores, most and least recognized plants and animals are similar in the adult and children's cohort, age and location of home are associated with scores for children, and ethnicity is associated with scores for adults.

Adults were able to recognize a greater number of plants and animals than children, which was expected from the literature on generational loss of knowledge. However, the most and least recognized plants and animals are similar in the adult and children's cohorts. Furthermore, the frequencies for the most recognized plants and animals reveal a noticeable pattern. As in the free lists, the most frequently recognized animals are common creatures that can be seen near the home, diurnal, and are reported as pets. For example, the tarantula, the most recognized of all of the animals in the children's and adult cohort, is kept by several children as pets. Adults also reported keeping tarantulas as pets when there were children. Even the high school science teacher has a tarantula in a cage in the classroom for students to feed and care for.

Another frequently recognized animal, the horned toad is also kept as a pet by many children and adults when there were children. Other frequently recognized animals are the roadrunner and the scorpion. The roadrunner, an icon of the Sonoran Desert, is seen commonly especially in the summer months during across the highway or hunting for snakes in backyards. Scorpions are abundant around the foundations of the house as well as hiding under rocks and in crevices. Children and adults both reported seeing them often while playing outdoors and several told stories of being stung by one in the past. Finally, the javelina, salient in both cohorts, is a local character in the community of Ajo.

They are seen moving in herds through the washes and alleyways late at night, but can also be seen during the day. I recall my first week in Ajo, I was walking to the bank and just as I rounded the corner from the central plaza onto the side street I saw (and smelled!) three javelina crossing the road and moving along the sidewalk toward a break in the fence line where they casually snuck inside and moved down into an overgrown wash.

The most recognized plants share commonalities as well. These plants are some of the largest plants on the desert landscape and are commonly found close to the home. An informal plant survey was conducted within a one mile radius of my house, which was located near the central town plaza of Ajo. The survey revealed that 13 out of the 20 plants included in the recognition exercise could be found in and around the neighborhoods of Ajo. The saguaro, a symbol of the Sonoran Desert, along with the prickly pear, organ pipe cactus, and palo verde all grow in many yards in town and are scattered along the foothills of the surrounding mountains. The saguaro, organ pipe cactus and the palo verde are also quite large and hard to ignore on the landscape. The prickly pear, although not tall like the columnar cacti, grows to be a large plant that spreads out along washes and fence lines. Its deep purplish fruit are abundant during the spring and summer.

The least recognized plants and animals have two things in common. Three of them, the lesser-long nosed bat, spadefoot toad, and the elf owl are nocturnal. Secondly, these creatures are all listed as protected or endangered species. This would suggest that because they are not see often, both adults and children have the least experience or exposure to these particular animals. For example, people often told me how there used to

be more rain in the desert, and during hot monsoon summer nights, the sound of the spadefoot toad, who emerges from underground after hibernating during the 10 dry months of the year, would be deafening. The pronghorn, whose numbers have now dwindled to a mere 30 as approximated by the Arizona Fish and Wildlife Service, was once abundant in and around Ajo as well. One older gentleman recalls driving out in the desert and seeing herds of them, running along with his car…and beating him! The near absence of these animals on the landscape suggests that both children and adults are no longer exposed to them and thus less knowledgeable.

The plants that go unrecognized hold a different story. At one time the beargrass, jojoba, tepary bean and sacred datura were all important cultural plants for food, basket making, ceremony among Mexicans and O'odham. Many of their uses such as mormon tea for bronchial congestion or appetite suppression have now become obsolete in a world where you can go to the local pharmacy for treatment rather than seek treatment from known plant sources in the desert. The lesser recognized plants are also some of the smallest plants in the list of 20 included in the recognition test. So, unless one is seeking out the plant, they would be easier to miss than say, a columnar cacti among the desert scrub.

Comparisons of mean scores with demographic characteristics did not reveal significant relationships for most variables. Age and location of home are associated with scores for children and ethnicity is associated with scores for adults. The strongest association was the linear relationship between score and age with children. As Zent (2001) notes, "Admittedly, any interpretation of the cultural significance of age on ethnobotanical knowledge is necessarily complicated by the fact that age is naturally

associated with the learning and accumulation of knowledge in any cultural context" (211). However, because past ethnobotanical research has found that by age 12, most children have acquired much of what they will know about plants as adults (Stross 1972, Zarger and Stepp 2004) it was not expected that plant and animal recognition would be associated with age in such a linear fashion. I propose that the increase in plant and animal recognition with age in the children's cohort could be due to several factors. First, since experience increases with age, older students have had more opportunities for exposure and experiences in nature and thus develop more recognition skills in addition to mere naming. Second, in 2005, all of the 7th graders (now 9th and 10th) participated in a science project in collaboration with the Organ Pipe Cactus National Monument to create a pond for the desert pupfish, and endangered species to the Sonoran Desert. During that time, they traveled to the monument for several visits and learned a lot about the Sonoran Desert through their studies. This trip was not something that I had expected would have such a great impact on their scores, so I believe that this could account for some of the higher scores among older children. On the other hand, if higher recognition scores and greater naming competence was directly affected by the school field trip, then this supports the idea that hands-on learning is an effective way to educate children about biodiversity.

Location of home was also associated with higher recognition scores in children. This could be due to the fact that children who live in more remote areas of Ajo, or on the Tohono O'odham reservation may have more exposure to desert plants and animals. This variable may also serve as proxy for parent occupation. For example, if their parents live

outside of town on a ranch, they may work in an occupation that would render them ore knowledgeable about the desert and thus more apt to teach their children about the desert.

Ethnicity was a significant factor in adult scores with Tohono O'odham scoring highest (35.00) in comparison to Anglos (32.00) and Mexicans (28.80). Although ethnicity was not significant in the children's cohort, there was variation among scores. Particularly surprising was that the scores for Tohono O'odham children were the lowest of the three ethnicities represented. One could assume that the Tohono O'odham children, having such a long history and cultural ties to the Sonoran Desert, would have higher scores, but in fact, their scores were the lowest (16.75) in comparison to Anglos (17.90) and Mexicans (17.42). When comparing individual plant species like the devil's claw for example, that were once culturally important to the O'odham for making baskets and eating its tiny black seeds, the O'odham children did not have as high recognition scores as the Anglos or the Mexicans. While at first perplexing, during my time in Ajo I had numerous conversations with the school counselor, teachers, and community members who described some of the socio-cultural problems occurring on the Tohono O'odham Reservation, where many of the children included in the study live. There is currently a high rate of diabetes, drug and alcohol addiction, and domestic violence that has created a difficult social environment. Many of their social networks have been broken in the process and many of the parents have fled the reservation to the urban areas of Phoenix and Tucson, leaving the children to live with a grandparent or other relative. The children are often moved from home to home and many do not finish school. This reality could have an effect on children's opportunities for learning especially when much of the learning is assumed to take place in a social environment of mentoring.

One of the most surprising findings in conducting the demographic analysis was that grandparents living in the home did not have an association with recognition scores. My initial proposition had been that having a grandparent in the home would increase what children know about the Sonoran Desert since it has been widely noted that cultural transmission of knowledge often happens between generations. Living under the same roof would provide an opportunity for children to learn from their grandparents. However, during the course of my field work, I found that the relationship that develops between grandparent (in the traditional role of grandparent) and child, and grandparent (in the role of primary caregiver) and child is quite different. I interviewed several grandparents who were indeed raising their grandchildren and they talked about how tired they were to be doing the job of mother for the second time around. Many had health concerns of their own, financial instability, or simply did not have the time to play a more traditional role of nurturer or mentor for skills and beliefs as had happened in the past. I would have thought that adults however, who had grown up in a household with a grandparent would have had a much different experience. However, in my small adult sample, only seven of the 19 had grown up in a household with a grandparent and three of those had the grandparent as the primary caregiver. Research by Setalaphruk and Price (2007) in Thailand focusing on children's knowledge of wild foods also showed no difference in naming abilities between children raised by their parents and those raised by a grandparent. According to Setalaphruk and Price, a possible explanation is that children have vast social networks in which to gain knowledge including parents, grandparents, siblings, cousins and extended family, and peers. Theoretical or naming abilities may be gained more passively and through various channels whereas more practical knowledge

on use or skills is gained primarily through a grandparent or elder. So, because this study focused on naming for reasons explained in Chapter Three, the role of the grandparent may be diminished in this case.

Conclusion

In this Chapter, I have presented what children and adults know about plants and animals by looking at what they name, what they recognize and how they talk about them. Participants know and name many native desert plants and animals. The younger cohort and adult cohort's lists are similar in several ways. First, they both contain dangerous animals such as the mountain lion and the rattlesnake which are salient and frequently named. Their salient plant items are large such as tree species including the palo verde, mesquite, and ocotillo as well as columnar cacti. Both cohorts included cactus fruit and animals such as rabbits on their wild foods lists.

Animal and plant lists differ between the adult and children's cohort in content and specificity. For example, the average list lengths of adults was longer for animals (21 vs. 12), plants (11 vs. 5), and wild foods (7 vs. 3). The adult cohorts lists were more specific with fewer generic names, and the adult lists included more native plants than the children's lists. The most named and recognized plants tend to be large and found close to the home. The most recognized animals tend to be diurnal and are also found close to the home.

Mean comparisons with demographics demonstrate that recognition scores are associated with age and location of home in the children's cohort and ethnicity in the adult cohort. The lack of significant difference between knowledge and demographic

factors such as gender, language, and years of residence raises questions concerning how knowledge is learned and whether there are differences between those who learn through direct experience and those who learn from books or other media.

In Chapter Five, I will examine the question of how participants learn in order to further address the overall research question which is Does knowledge about plants and animals change based on learning contexts? The data presented in Chapter Five will help to determine if the theory that children's shift from experience-based based to media based learning is supported and will also help to identify vertical or horizontal reported transmission of ecological knowledge. Chapter Five will also address the subject of knowledge change by once again comparing data between the two cohorts of study participants. Analysis will identify variation within and between the two cohorts on cultural transmission and learning styles. I will examine educational changes that have taken place over the generations that may explain why certain knowledge persists. This data will be drawn from interviews, narratives, and my own community experiences.

Chapter 5

Cultural Transmission and Acquisition of Ethnobiological Knowledge

Figure 5.1 Annie, my pottery teacher (far right) and members of our class stand outside where we are building a fire made of cow dung. Traditional O'odham methods used cow dung in order to fire their pots. Since cows were brought by ranchers, this is an example of how O'odham culture was influenced by the arrival of ranchers to the region.

I had my first experience with a non-western form of education while taking a Tohono O'odham pottery class in the summer of 2006. The class was taught by Annie, a an O'odham teacher who lived on the nearby Tohono O'odham Reservation.

Excerpt from field notes August 2006:

She began the class in a quiet voice, explaining that her mother and sisters had taught her to make pottery as a child. While she talks

Annie is looking down at her hands where she is quickly shaping a ball, rubbing the clay between her palm and forefinger and smoothing it using the inside of her palm. She begins to explain the process of collecting and preparing the clay, a process that takes four hours to provide for the 13 of us in the class. There is a hill near her village where she finds clay in colors ranging from gray to brown and reddish brown. She collects the clay and once home, pounds it into a very fine dust, sifting it to remove the gravel and rock. Water is added to the sifted clay and it is placed in bags to keep it moist. Her story makes me appreciate the rich red color of the clay and its texture which is surprising smooth and pliable, reflecting her hours of work.

At this point, I expect that she will begin explaining step by step how we should start making our pots or perhaps provide us with a handout detailing instructions. But, Annie simply instructs us to "roll the clay into a ball and then pinch the center and make your pot". We are learning to make 'pinch pots', a traditional O'odham style of pottery using no mold or wheel, only one's hands. One by one, we pick up our clay and begin rolling it in our hands. At this point we are glancing around at our neighbors wondering what to do next. We mumble amongst ourselves as we begin to experiment with our technique while trying to steal glances at Annie, the pot quickly forming in her hands.

A lady to my left asks, "What do we do next?" and Annie replies, "start shaping your pot. Widen the hole in the center like this". We

immediately begin to copy this technique, sharing advice with our neighbors, looking over our shoulders, and comparing our progress. Each stage happens in a similar way. Annie has begun making rounds about the room showing people her technique or commenting on our work. She is quiet, pensive, observing, but occasionally commenting, "Not too much water. It will need to dry out". We are beginning to realize that Annie is clearly a woman of few words. But, perhaps words are not really that important.

Figure 5.2 Traditional O'odham pots are laid on top of the cow patties, which are set on fire. The pots are covered in order to reach an optimal fire temperature to seal the pots.

Annie's instruction, based less on words than on showing and doing reminded me of how people used to learn. For example, learning about the natural environment

occurred through hands on experiences during foraging or other subsistence activities, or through storytelling and participation in rituals and songs, all of which allowed for informal, interactive, and situational hands-on learning such as during our pottery class. Today, informal learning experiences have largely been replaced in the United States by formal or western modes of education. The differences between the two are substantial. One is that formal learning tends to be passive where instead of learning through imitation and experimentation, learning is mostly verbal, depending often on rote memorization. As our methods of learning change, so to does our content of knowledge. For example, although formal schooling may impart a larger quantity of information when compared with what one can learn through informal methods, the quality of information has changed, with children learning the *what* but not the *how*.

Previous research has identified several factors that appear to contribute to ecological knowledge loss or change in younger generations. These factors range from a lack of motivation, and changes in occupation which make it unnecessary to learn environmental knowledge, which is often the case when moving from rural to urban areas (Krech 2005). However, few studies have focused specifically on learning and how a shift in the style of learning can affect knowledge.

Situated, social learning that occurs during apprenticeship or subsistence and foraging activities imparts a different kind of knowledge than what is learned in the classroom or through books and television (Chipeniuk 1995, Rogoff 1994). For example, social and situated learning contexts that occur during hands-on activities have cognitive effects that improve learning and memory retention (Blakeslee 1980, Nabhan 1994). Because our memory is directly linked to our senses, the powerful images evoked

through sounds, smells, touch, and tastes can be crucial to our learning about living things. Secondly, when we learn from books or television the information is often non-local and may include declarative knowledge such as names, rather than more cultural knowledge involving uses, skills, beliefs, and practices (Atran 2001). Gatewood's (1983) theory of loose talk addressed this phenomenon proposing that when we acquire environmental knowledge in abstract ways, we may learn how to talk about a particular domain, like trees, without having any experiential abilities such as recognition or use. This scenario played itself out again and again during interviews when participants would name the ironwood tree during the free listing exercise but were later unable to recognize the tree in the video. Many of the participants named the cactus fruit as an important wild food on their lists, but where at a loss when questioned about how or when to harvest the fruit. One of the goals of this dissertation is to examine how learning has changed across generations. It is expected that when methods for learning shift from experience-based to more abstract, the content of knowledge will change as well.

In Chapter Four, I presented and discussed data on what children and adults know and how their knowledge varies both within and between generations. In this chapter, I will concentrate on identifying and describing the type of learning reported among children and adults and determine if learning methods are associated with recognition scores. Focus questions will be, Do participants who learn primarily from books and television know different information than those who report learning mostly from people or experience? Is ecological knowledge transmitted vertically, from grandparent or parent to child, or horizontally from peer to peer or among siblings? What are the differences between those who learn from media and those that still learn from a parent or

experience? Narratives from open-ended interview questions will be presented in order to explore the content of their knowledge, and to present emerging themes on learning and changes that have taken place in the region. The overall goal is to identify patterned variation and distributions according to how information was learned.

Indigenous Versus Western Models of Learning

Indigenous models of learning such as the one used in the pottery class, emphasize learning while doing and rely on social and situated means of transmitting information. In contrast to western models of education which often stress information, indigenous models of education are more social and holistic in that they meet a greater range of a child's mental, social and spiritual needs (Nichol 2005). Learning is described as experiential in that in addition to verbalization it also stresses observation and imitation in daily tasks or a specific skill.

Indigenous education is also multisensory and tactile involving touch, site, tastes and smells and contextual in that every part of social life is connected to religious beliefs and practices. In this regard, the education process is embedded within the rituals of everyday life. Finally, indigenous models of education emphasize social relationships. In fact, social structure is often shaped by access to knowledge and information (Nichol 2005).

Indigenous models of education stress intergenerational learning and the relationships that form between the student and the teacher. Samuel, a Tohono O'odham friend of mine was talking with me one day about why younger generations of O'odham do not know what the elders know. He said that the elders are sometimes reluctant to

share their knowledge of plants, medicine, and healing songs with younger people because they feel that younger people do not appreciate the information, or are not willing to earn the knowledge. But, when younger people are persistent, the elders will sometimes take on the role of teacher. Samuel relayed a story of a friend who wanted to learn the Tohono O'odham songs. He went to a woman who was known for singing songs and asked her if she would teach him. Every time he would ask her, she insisted that she did not to know any songs and refused him. Being a persistent man, he returned to the woman three times. Finally, during his third visit, she decided that he must really want to know the songs and so she taught him. The man had proven his worthiness to be a student, and in the end, developed a close relationship with the woman singer.

Education was also specific and relevant to the normal flow of daily life. Learning the name of a plant and how to prepare and cook that plant might happen over the course of a day, while collecting food and preparing it for dinner. One might learn from watching at first, and then trying it out or imitating for themselves. Learning would also involve interactions between the teacher and student, with the student asking questions and thus actively participating in the process. Learning was therefore a social activity in that it involved watching, talking to, and imitating others who were more knowledgeable. Vygotsky refers to this as scaffolding, when a more knowledgeable person takes on the role of teacher, guiding learning and development of the student (1978).

Situated learning incorporates the idea of learning and knowledge as a process, and looks to such social and cultural practices as apprenticeship to demonstrate how knowledge is generated in the practices and the routines of daily life (Lave 1997, Rogoff 1990). Learning through practical experience is presented by Chipeniuk in his description

of childhood foraging as a means of acquiring competent human cognition about biodiversity in rural Canada. In his study, people who spent more time foraging for wild foods as children were found to have a better sense of biodiversity as adults (Chipeniuk 1995). I found similar results when comparing knowledge between adults and children. Adults had greater naming and recognition expertise and had also had more direct experiences harvesting wild foods as children.

Cultural knowledge that is ecologically focused, involving names, uses, beliefs, and skills about plants and animals has also been linked to social and situated learning activities (Chipeniuk 1995, Hunn 2002, Nabhan 1994, Ohmagari and Berkes 1997, Ross 2002, Ruddle 1993, Setalaphruk and Price 2007, Stross 1973, Wyndham 2004, Zarger 2002). Stross (1973) emphasized the social nature of learning among the Tzeltal Maya by describing the way in which children acquire botanical terminology, which is situated in daily routines such as accompanying a parent or grandparent into the garden and along trails and paths in the community. Ohmagari and Berkes' (1997) work with the James Bay Cree and Norbert Ross' (2002) research with the Lacandon Maya demonstrated that loss of contact between children and elders resulted in changes in cultural transmission of knowledge and ultimately, a loss of ecological knowledge among younger generations. Raffles'(2002) research with Amazonian river-dwellers and Chipeniuk's (1995) work with childhood foragers in Canada revealed that the social and environmental contexts in which learning take place influence the content and retention of nature knowledge; an absence of situational and interactional learning experiences in younger generations demonstrated a loss of knowledge, particularly more traditional knowledge such as belief

and skills. Thus, the literature indicated that the content of what is known changes when the method of learning changes.

Memory, Story and Landscapes

In addition to apprenticeship and guided instruction, social learning also occurs through storytelling, which in the past was the most prominent method of cultural transmission in Native American populations (Caduto and Bruchac 1991). Among Tohono O'odham for instance, elders traditionally played a large role in informal learning through storytelling and guided participation (Nabhan 1994). As Samuel's story exemplifies, stories are still regarded by elders as sacred and protected. Learning through story is unique in that it is interactive, whereas learning by reading a book or watching a video are passive activities. Telling stories promotes dialogue between the teller and listener, and brings creativity and imagination to the learning process (Cajete 1994). Cajete cites the use of story as the mythic foundation of American Indian education, setting it apart from Western education. Cajete notes that the story is a universal part of communication and learning since it is one of the basic ways that the brain structures and relates experience. According to Cajete, tribal myths teach accounts of the world as experienced and interpreted through history and are filled with metaphor, symbolism, and images that allow for creative interpretation (Cajete 1994).

Story is also one of the first ways that humans stored information before the advent of external memory devices (Donald 1991). Stories were not only a way teach, but were also a way to store cultural information and impart social memory, as is the case with the above example. Basso (1984) worked with the Western Apache in Arizona and

researched their use of place names to tell stories, convey historical information and enforce cultural norms and taboos. Songs are also used to store and transmit information. Roseman (1998) found that the Temiar of Malaysia use songs to relay spatial and historical information about the local landscape.

Lorraine, an Hia Ced O'odham elder that I interviewed recalls that Fall was the time for storytelling in the village where she grew up. With the cooler weather of the fall, it could be assured that all of the snakes would be in hibernation, so they could sit on the ground around the fire and listen without fear.

"The stories would go on and on…sometimes for hours. It was hard to stay awake and often I would fade off into sleep. But we'd be scolded for not listening. Most of the stories were about people migrating back and forth between Dome Valley in the Black Hills and the Quitobaquito spring, now located in the Organ Pipe Cactus National Monument."

Figure 5.3 Quitobaquito Spring, located in the Organ Pipe Cactus National Monument. The spring has been and still is an important year-round source of water for both humans and wildlife.

Memory is long known to have important linkages to senses. For instance, our ability place a familiar smell from childhood with a particular time and place is sometimes startling. Psychologist Roddy Cowie has been looking at how memory is connected to sensory experiences in the natural environment and has hypothesized that direct experiences and memories that occur in natural environments "have the power to move us, and draw us, and motivate us" (2002: 133). He calls these experiences "charged" in the sense that "landscapes have the power to be invested with an emotional and moral charge". Through story we are able to once again grasp at these charged memories.

Cultural Transmission and Contextual Learning

Educational systems, both formal and informal, comprise one of the various ways in which cultural knowledge is transmitted to the individual. Cultural transmission involves the teaching and learning of varied knowledge in a society and primarily serves two functions in all societies: recruitment and maintenance (Spindler 1997). In the past, teaching and learning were rarely differentiated and this has been criticized (Garro 1985, Lave 1991, and Wolcott 1997) since the two are far from mutually exclusive. Wolcott (1997) stresses the importance of distinguishing between teaching or transmission of knowledge and learning or acquisition of knowledge. It is now more widely accepted that what is taught is not necessarily learned and what is learned is not always learned in a formal manner, but rather through informal learning grounded in daily experience.

Research on cultural transmission of knowledge has historically taken an evolutionary perspective, incorporating the cultural and social complexity as influencing

the manner in which knowledge gets transmitted. Researchers have applied evolutionary biology theories to the transmission of cultural traits. The Cavalli-Sforza-Feldman model of cultural transmission states that in more traditional societies without a lot of outside influence, knowledge will be transmitted vertically from parent to child. In this case, knowledge is highly varied within the community, yet stable and slower to change (1981). In societies where there has been more development in terms of outside influences and modernization, transmission will take place horizontally, from peer to peer or between siblings. In this atmosphere, cultural knowledge is more homogeneous, spreads faster, and is less stable.

Recent studies on the transmission of knowledge has focused on describing the process of knowledge acquisition and gathering empirical data to distinguish between horizontal, vertical, and oblique transmission (Reyes et al. forthcoming). Reyes et al. found that among the Tsimane, a group of Bolivian foragers and farmers, transmission of knowledge, such as names happened vertically, from parent to child whereas skills were transmitted horizontally, between siblings and peers.

Research focusing on the transmission of cultural knowledge has identified socially structured learning experiences that are most important for acquiring specific skills and aspects of knowledge (Lave 1997, Lave and Wenger 1991, Hutchins 1991, Rogoff 2003). Social learning theories build on foundational work in psychology and emphasize the role of culture in shaping the cognition and development of children within community contexts (Rogoff 2003, Rogoff and Lave 1984). For example, Vygotsky (1978) proposed that potential abilities develop through a process of guided instruction involving social interactions with others who are more knowledgeable and

thus represent the shared knowledge of the culture. The term situated learning incorporates Vygotsky's theories on learning and knowledge as a social process.

Social and cultural practices such as apprenticeship and guided participation are examples of how knowledge is situated and generated in the routines of daily life (Brown and Collins, and Duguid 1996, Henze 1992, Lave 1997, Rogoff 1990, Tripp 1996). The importance of such experiences for learning cultural knowledge has been emphasized in numerous ethnographies of childhood (Mead 1928; Mead and Wolfenstein 1955, Morton 1996) and child development studies (Greenfield and Lave 1982, Pelissier 1991, Schwartzman 1978, Whiting 1963, Whiting and Whiting 1975).

Excerpt from field notes: October 2006

> *"As I arrived early one morning for my third day of interviews at the Ajo Middle School I noticed a large group of students crowded around one of the open areas of desert scrub just outside of the library door. It was typical for students to mingle in the open courtyard of the school shortly before the start of classes, but this morning was different. There was an unusual amount of talking and chatter as the crowd drew larger and closer together. As I approached, I could see that they were looking at something. One student pointed while two girls shrieked and darted from the crowd. I popped my head between two students and saw what it was that had drawn such a large audience. Stretched out across the sand, entangled between two snarled creosote bushes was a gopher snake, out for a morning nap in the warm October sun. It was large, perhaps 2 feet long, scales shiny. I am sure that the snake was as surprised as the*

children at this random meeting and now, both creature and children were motionless, not really knowing what to do. "Touch it!", shouted one of the boys, daring his friend as he pushed him toward it. "No way! It's probably poisonous!" exclaimed another. Just then the snake slithered a few inches forward, planning its escape or just testing the waters, and the entire crowd gasped and stepped back. As I stood there watching I noticed the faces of the children. Their eyes were glued to the snake in total fascination and awe, fear, and interest."

As I later reflected on the incident, it reminded me of children's need for direct contact with nature. Earlier in my studies I read a book by Gary Nabhan and Stephen Trimble titled the *Geography of Childhood*. Through a series of essays, the authors discuss the impact of plants, animals, and the natural world on children and how this relationship has changed significantly over the past several decades. As a child growing up in suburban Virginia, I had spent the majority of my time outdoors, unchaperoned with neighborhood friends exploring the nearby wood plots and making discoveries and explorations that led to hours of endless fascination. What the book, and many subsequent articles and books that I have read since (see Kahn and Kellert 2002, Louv 2005, Sobel 1996 and 2002) emphasize is the importance that the natural world plays in children's development, especially in the development of a curiosity for nature and living things.

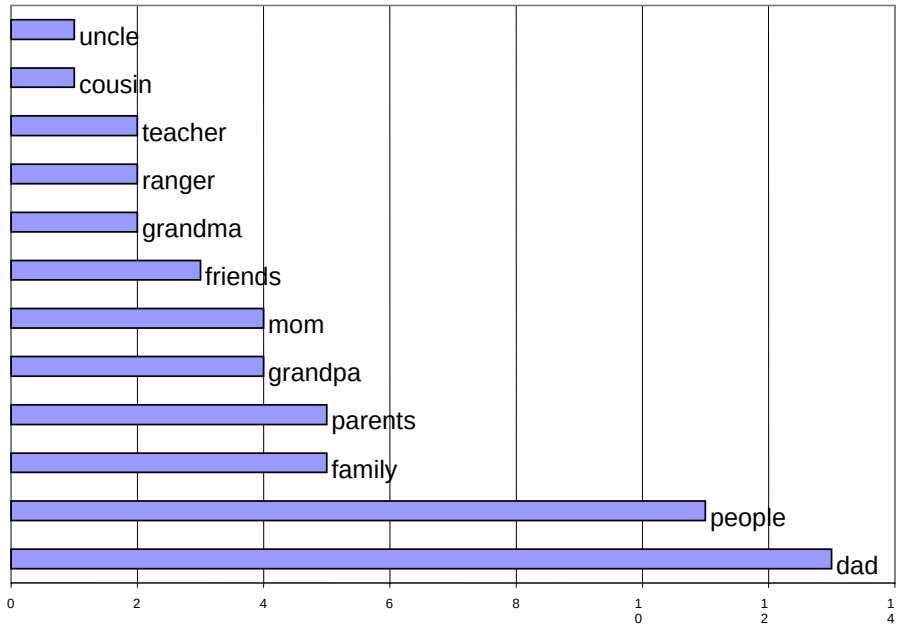
The results presented in this chapter are taken from the recognition tests discussed in Chapter 5 and data from structured and unstructured interview questions that followed

the administration of the tests. When questioned about learning, the adult cohort was asked, "How did you learn or from whom did you learn *as a child*" in order to obtain a perspective on learning changes over time.

Distributions of Reported Learning

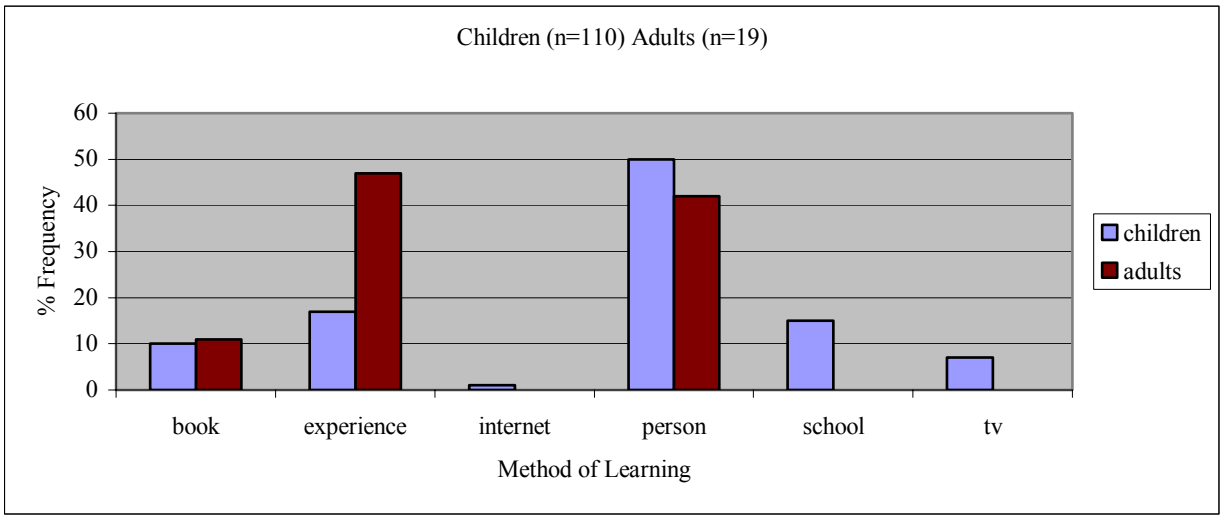
When asked, "How do you usually learn about plants and animals?" Forty-eight percent of children participants reported learning from people. These included dads, grandparents, uncles, teachers, and friends (Table 5.1).

Table 5.1 Frequency distribution of people reported as teachers by children.



Children reported learning from school and experience at 16% each, followed by books at 9%, television at 7%, and finally the internet at 1% (Table 5.2). Adults named experience as the primary way that they learn about the desert, followed by people and books (Table 5.2). Most commonly named people were dads and parents.

Table 5.2 Frequency distributions for reported methods of learning for children and adults.



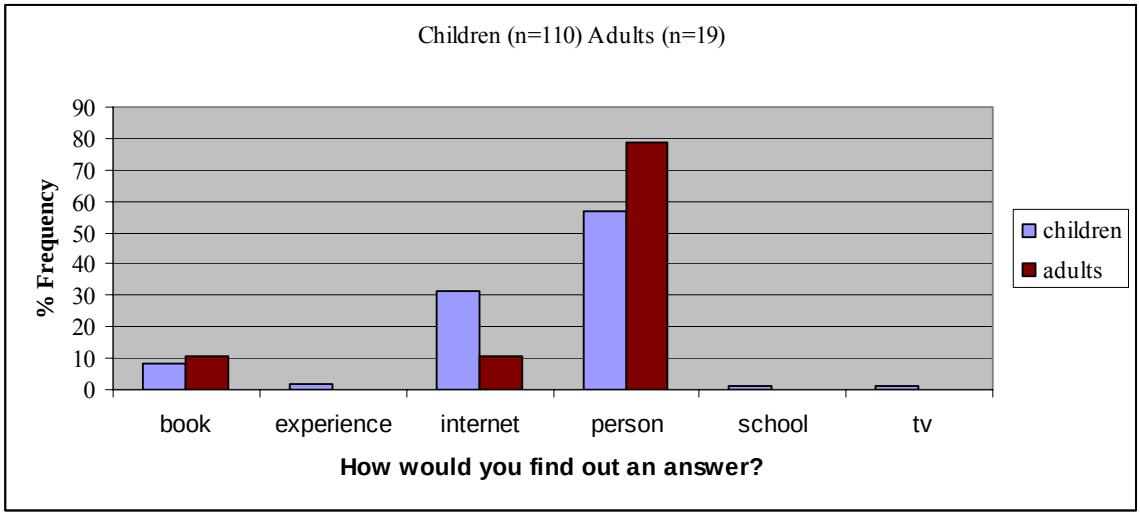
Mexican children named learning from a person most often (53%) followed by Anglos (46%) and Tohono O'odham (42%). Television was identified most often by Tohono O'odham children (17%) for learning about the desert followed by Mexicans (11%). None of the Anglo participants cited television as a way that they learn about the desert.

Tohono O'odham adults named learning from experience 100% of the time, followed by Anglos (40%) and Mexicans (30%). People were named as most important to Mexican adults (60%).

When asked, if you had a question about the Sonoran Desert, how would you find out the answer, over half of the children participants said they would find out from a person (57%) while 31% cited the internet. Books were named by 9% and experience, school and television were only named by a few (see Table 5.3).

Adults named people as the most important way that they would find out an answer about the desert (71%) followed by books and internet both at 11% (Table 5.3).

Table 5.3 Frequency distribution of how participants would find an answer about the desert.



Children reported spending their free time playing sports (33%), riding all terrain vehicles (atv's) (11%), watching television (9%), and various other activities ranging from skateboarding to listening to music. Males were five times more likely to report a desert-based activity such as riding atvs or camping than females. Females reported doing more indoor activities in their free time such as reading or talking on the phone.

Children who still participate in experience-based outdoor activities in the desert environment with family members such as hunting report learning more frequently from family members than from books or school. For example, 81% of kids who hunt regularly reported that they would go to a person to find out an answer about the desert in comparison to 52% of other kids. 75% of participants who hunt report learning from a person compared to 46% of others. Adults reported hunting frequently both as children and today. 80% of adults who hunt report learning from a person or through experience and 70% of adults who hunt would ask a person to find out an answer about the desert.

Means and Group Comparisons

Mean score correlations with recognition scores were computed using a ANOVA analysis of variance test which compares means for the following behavioral variables: Hunt (Do you ever go hunting?), Park Visit (Have you ever visited one of the national or state nearby parks?), Learn (How do you usually learn about plants and animals?), Answer (If you had a question about the desert, how would you find out the answer?) and Activities (what do you do in your free time?). Results are based on three levels of significance: . $\alpha = 01$, $\alpha = .05$, and $\alpha = .10$.

For the children's cohort, the relationship between the recognition test score and the variable Hunt is statistically significant ($f = 2.866$, $p = .093$) at the .10 level. The relationship between recognition test score and the variable Park Visit is also statistically significant ($f = 6.052$ $p = .015$). The relationship between the recognition test score and the variable Learn was statistically insignificant ($f = .969$, $p = .327$). The relationship between the recognition test score and the variable Answer was statistically insignificant ($f = .601$, $p = .699$). Lastly, the relationship between the recognition test score and the variable Activities was statistically insignificant ($f = .591$, $p = .623$).

For the adult's cohort, the relationship between the recognition test score and the variable Hunt is not statistically significant ($f = 2.713$, $p = .118$) at the .10 level. The relationship between recognition test score and the variable Park Visit is statistically insignificant ($f = 1.356$ $p = .260$). The relationship between the recognition test score and the variable Learn was statistically insignificant as well ($f = 1.151$, $p = .298$). The relationship between the recognition test score and the variable Answer was statistically

insignificant (f = .548, p = .589). Lastly, the relationship between the recognition test score and the variable Activities was statistically insignificant (f = .923, p = .546).

Methods for learning ethnobiological knowledge was not associated with recognition scores or specificity. Children who report learning from people or experiences used specific names 66% of the time during the recognition exercise versus 65% for those who reported books as most important. Regarding how they would find out an answer about the desert, those who reported a person named specific names 67% of the time, followed by internet 64%, and books 68%.

Adults who report learning from people or experiences used specific names 86% of the time during the recognition exercise versus 79% for those who reported books as most important. Regarding how they would find out an answer about the desert, those who reported a person named specific names 86% of the time, followed by internet 79%, and books 76%.

Discussion

Previous research findings indicate that children in the United States name media as their primary transmitter of ecological knowledge. However, 48% of children participants in this study cited people, followed by school and experience (each 16%). Media (including television, books, and internet) only comprised a total of 17%. A possible explanation for differences between these findings and other researchers could be due to the methodological approach. Because the open-ended questions, such as "How do you learn?" followed the recognition exercise, participants may have been primed to answer this question in relation to how they learn about the desert, or specific plants and

animals in the study rather than generally how they learn about the environment which would include non native environments. It may be that children still learn about the desert from people, but about nature or plants and animals in general from television, books, or the internet.

Another finding that differed from previous research is that children reported vertical transmission for learning knowledge and had a low frequency of naming peers or siblings. This could again, be due to the methodological approach which asked participants to self-report how they learn. In self-reports, people tend to overestimate vertical learning (Bernard 2002). Nevertheless, through the course of the interviews I found that peers play an important role in the *opportunities* for exposure to nature. For instance, many of the children that I spoke with only go out into the desert if accompanied by their friends. During free time, they are more likely to go quading or hiking in the desert with a friend than by themselves. During my weekly observations at the Ajo Community Center and local parks I rarely saw a child playing alone, but rather were accompanied by three or four friends or siblings. So, the importance of shared experiences such as play time for learning should not be underestimated.

Another finding is that hunting is significantly associated with recognition scores. This is not surprising since hunting provides participants with an interactive and situated learning experience. Post-interview discussion with my research team revealed that children who hunt demonstrate an intimate familiarity with the local landscape. For example, while viewing the video clips, hunters were able to immediately identify tree species just from their silhouettes. Hunting is unique in that it offers the participant a hands-on multi-sensory experience that is also very social and ritualistic in the way that it

is carried out. Families that I became friends with in Ajo had very systematic behavior with regard to hunting. They would usually return to the same places, year after year and with the same group of people, usually extended family members and sometimes friends. And returning from the hunt with food was always cause for a celebration of food and family. When I accompanied my friend John on a quail hunting trip, we were lucky enough to bring ten back with us (they are rather small so you really need a couple for each person to call it a meal) and I prepared dinner for family and friends using a recipe given to me by John's mother, thus extending the social part of the trip. Hunting is also unique in that it often brings together a person's extended social network like including a relative such as an uncle who may not live nearby or have everyday contact with the family. While inquiring about how often children see extended family, many reported only seeing their uncle on yearly or bi-yearly hunting trips.

Park Visits were also significantly associated with recognition scores among children but not adults. Again, the 2005 park visit with 6th and 7th graders (now 9th and 10th) could account for some of the higher scores among children who visited the park and participated in the project. Another explanation could be that children who visit parks may have more personal interest in nature and thus be more motivation to learn. Or, perhaps they have parents who are committed to teaching their children about the environment.

Finally, how participants learn and find out answers about plants and animals had a statistically insignificant association with recognition scores in both children and adult generations. I expected there to be a significant correlation between how participants learn and knowledge scores because learning from experience evokes a different type of

knowledge. However, with verbal based learning having such a large role in education today, one is able to learn the name or how to recognize a referent in a very abstract way, such as seeing it on the internet or by hearing it talked about on the television (Gatewood 1983). In that sense, Gatewood suggests that learning to talk about a referent is more important than knowing specific knowledge about that referent. So from this standpoint, names and recognition need not be transmitted in more social or experiential ways. However, much of what children participants know is limited to theoretical knowledge such as names and the skill to recognize something in a video and more in-depth ecological and culturally-based knowledge is lacking. Thus, experience based or social learning does not seem to improve one's ability to name and recognize plants and animals, but can improve skill or use based expertise which is typically learned in more hands on or experience-based ways. In retrospect I would have included practical knowledge tests along with naming competence. The next step will be to create a questionnaire of use and belief questions to distribute to children and adults who participated in the study which I imagine will more accurately measure differences in learning..

Themes and Narratives on Learning and Change

The interview narratives that arose during open ended questions and informal conversations, and observations that occurred during participation in community educational activities help to explain patterns in the quantitative data from the naming and recognition exercises. The narratives also provide ethnographic detail on the content of what is known about Sonoran plants and animals. The selections below are a sample of

quotes which express the emergent themes of the interviews and exemplify learning and personal experiences within and between the children's and adult's cohort.

One of the themes that arose during interviews is the many places that children see or have experiences with plants and animals. These include: the desert, while hunting, at the park, near the house, at a family farm or ranch, at the zoo, in the school yard or while hiking, walking, or camping in the desert. One of the themes that appeared particularly often is seeing plants and animals at their grandparents house. On several occasions while visiting friends in their homes one of the adults would call to their child, 'run out to the garden and bring me some chilies'. Below are a few excerpts from children's interviews on their grandmother's houses:

> "That's the Gambel's quail..I see 'em in my grandma's yard"
>
> --Interview C02

> "Sometimes I see it in my grandma's house. They come and drink water. It has sugar in it or something."
>
> --Interview C08

S: I've seen those (agave) before.
C: And where have you seen them? Do you remember?
S: At my grandmother's house.
C: Does she have them planted?
S: Yeah. She has some other stuff planted too.

--Interview C20

Children reported having various types of contact with plants and animals from abstract such as seeing it on television or while riding in a car to direct contact such as while camping or hiking in the desert. While watching the video clip, many of the participants reported that they had seen a plant or animal, but either did not know or

could not remember the name. This was perplexing to me, because often the individual was able to describe in detail where they'd seen a particular plant growing but yet did not know its name.

S: Yeah, I've seen them [brittlebush] before.
C: Where?
S: Around my house, and in the washes, and then right when you walk on the sidewalk, sometimes.
C: It's called brittlebush.
S: Brittle bush?
C: Have you heard the name of it before?
S: Yeah. I've heard it. It's hard to come up with the names, though.

--Interview C15

Children talked about plants and animals while they watched the videos often providing stories, ecological information, sensory descriptions, and beliefs.

"That's the spadefoot toad. You see 'em after it rains, and you hear 'em in the morning in the washes."

--Interview J08

S: Tortoise, a desert tortoise.
C: Yeah. Where do you see those?
S: When I go quading, sometimes, after it rains, they'll be in the washes, or they'll be in little, not muddy but damp, places.

--Interview C28

Both child and adult participants reported learning in various ways, mostly through family members, yet children and adults both named vertical transmission as their primary source of knowledge with respect to people. Since vertical transmission tends to be overemphasized in self reports, there may be more horizontal transmission happening than is indicated by the data. Below is an example of both vertical and horizontal transmission.

"We used to go out in the desert and pick bagfuls of 'em [ocotillo flowers]…you suck on that, the bottom, and it's like a sugary taste. My stepsister taught me how to do it, 'cause her and her dad were doing it one day."

--Interview G25

"Most of the time I learn names and what they are [plants and animals] from relatives of mine, like when we go out into the desert."

--Interview F18

The following interview excerpt is from an O'odham student and describes how he learns from relatives and why he learns more from his extended family than his parents. This excerpt also addresses the notion that elders have expectations for younger generations to learn.

C: How do you think that you usually learn about the desert?

S: My grandma and my dad…it's like you find something, and you're curious about it and you ask 'em about it and then they'll tell you what you can do with it, what you can't do with it, why they have a song for it…

C: And do they still teach you a lot or did they teach you more when you were younger?

S: Well, I hardly ever ask them questions so they hardly ever tell me anymore. But my cousin teaches me a lot because I'm always with 'em…he didn't grow up with his parents, so I don't know, it's like he never learned anything from his parents. You see, you learn everything from your aunts, uncles, grandma, grandpa.

C: Why do you think that you learn more from them?

S: Because they, they know you're supposed to know it, and so they'll ask you about it, about why is it there and then that's why he knows it because ever since he was little that's how it went.

--Interview C01

Whether or not participants name experience as a way that they learn, many of the children talked about specific experiences during their interviews.

"I pick the fruit with my grandpa.'Cause the saguaros he has are old, but we get 'em. We eat 'em. We eat the little seeds, and the insides. You open it, and then just eat 'em. Sometimes you have to get to them before the birds."

--Interview C15

Hunting is one of the traditional activities that is still widely practiced in Ajo today. Sixteen percent of children cited hunting as a regular activity, and the relationship between hunting and recognition test scores was found to be statistically significant among both children and adults. Participants reported hunting usually with a father or an uncle. In most cases, they are accompanied by a family member or another knowledgeable person.

"I went deer hunting with my dad and we saw some [big horn sheep] in the mountains. I thought it was really cool because I was so little…"

--Interview J02

"We've hunted them [cottontail rabbits] before. Normally we just hunt for quail and deer, but sometimes we come across a rabbit in a good spot, so we take it. We have a big group that goes hunting every fall. We go deer hunting. And during summer, my dad takes us quail hunting during the mornings sometimes."

--Interview J12

Interviews with adults often took on the theme of change, with participants citing ecological, social and cultural changes that have taken place in their lifetime. Some of the changes that have occurred is that desert plants and animals have less relevance to everyday life. The relevance of plants and animals has become less critical to survival in everyday life. Whereas once one might go to the greasewood for its pharmacopoeia of treatments from an a antibiotic to athletes foot to arthritis, now there is a remedy at the local drugstore. One 99 year old O'odham and Mexican woman that I interviewed had this to say about the desert (translated from Spanish):

"We had everything we needed in the desert…we had all the animals and plants at our ranch. We used the *hediondilla* for all sorts of things; smelly feet, stomach aches, diarrhea, bloating, canker sores, and arthritis. And we used the plants for other things too! We even made flyswatters from the *ocotillo*! Because, we didn't have money to go buy them."

--Interview C69

Many adults spoke of the restrictions on the land surrounding Ajo due to the creation of the federally managed Organ Pipe Cactus National Monument, managed by the NPS, the Bureau of Land Management, and the Cabeza Prieta Wildlife Refuge. When they were children, many recall being able to 'do whatever we want' on the land. One man recalled a childhood memory of riding on horses for hours and hours out toward the Growler Mountains and camping at night. He and a friend would stay out in the desert for days, hunting rabbit or quail, but resorting to eating cans of beans that they had stashed in their packs just in case they were not so lucky. Federal designations have restricted hunting to designated areas and times of the year on much of the land or none at all on the park service land. And, with the increasing presence of the border patrol, the surrounding desert is under surveillance at all times.

Still another change that adults mentioned are that there are less opportunities for children's experienced based learning. The poem at the beginning Chapter 4 "When I was Small" was written by an O'odham woman, but its message reverberates in the stories I heard from many of the Mexican and Anglo elders as well. In the past, grandparents were an important source of cultural information for younger generations and played an important role in storytelling and passing on traditions. Many adults recalled stories of their grandparents during childhood. My friend Janet Castro told me this story about harvesting cactus fruit as a child:

“The saguaro and organ pipes bloom at the beginning of April thru the end of June and then the blooms turn into a ripe bright red fruit that has a taste that is similar to watermelon. As a child I used to go with my grandparents way out in the desert to gather cactus fruits. We camped on the traditional ramada made out of mesquite poles, with a dry saguaro or ocotillo roof, and mud. In the corner, my grandfather built a hornilla, an adobe brick stove. To be able to have a good harvest, we had to camp for at least two weeks, and every day we would get up as early as five in the morning. By mid morning we had already three buckets full of the ripen red and pulpy fruit. To bring down the fruit we used a pitayero, which is a fifteen feet long dry saguaro pole with a small sharpen piece at the top. While my grandfather was collecting dry mesquite wood my grandmother and I scooped out fruit out of the fleshy husk and fill up the olla , and put it on top of the hornilla, and it would take five hours for the fruit to cook. My grandparents taught me to respect every living thing in this wonderful creation because without the cactus and plants we would not be able to survive in this harsh Sonoran desert. That is why the harvesting of the saguaro and organ pipe fruit has been an important tradition in the Tohono O’odham culture for thousands of years. The harvesting brings families together to celebrate the New Year and to sing and pray to bring down the clouds for rain.”

My first visit to Ajo in the summer of 2004 had revealed that high unemployment in the region has prompted parents to migrate to urban centers for jobs and leave children with an elder family member as the primary caregiver (O'Brien 2005). In this situation, children may have more opportunities for contact with elders, as opposed to less which could, in turn, increase the amount of learning that takes place between generations. However, one important factor that has changed is the role that the grandparent now plays in this area. Whereas before, a grandparent may take on the role of nurturer and temporary caregiver, freeing up their time for more activities such as taking their grandchildren out in the garden or fishing at a lake, their new role as primary caregiver leaves them acting "less like grandparents" and more like parents, stressed with the burdens of raising yet a second generation of children. So, although an increased contact with the younger generation does support the social conditions necessary for cultural transmission of ecological knowledge, this transmission is not occurring due to role changes in the older generation. However, as reported earlier, grandparents' homes are mentioned by many children as places where they see certain plants and animals suggesting that perhaps grandparents are still providing opportunities to see native plants in their home gardens.

Conclusion

In this chapter I have identified the type of learning reported by children and adults and described how knowledge is transmitted in order to determine if children who learn primarily from books and television know different information than children who report learning mostly from people or experience.

Findings indicate that naming and recognition abilities are not dependent on how the knowledge was acquired. Children who reported learning from school versus books versus experience did not have significant differences in naming abilities or recognition abilities. This could be because naming and recognition abilities may not require situated learning. Most of the adult cohort and certain child participants know more than just names including ecological information, beliefs, uses, and behavioral information about plants and animals. Some children's interviews provide detailed descriptions and narratives. But in almost every case, their memory draws upon a direct experience rather than a book or television program. This provides evidence to support the proposition that knowledge changes from more general to specific when learned through experience. The participants with the most procedural knowledge as demonstrated in their interviews are those that spend time in the desert—who hunt, ride quads, camp or hike on a regular basis, corroborating the theory that cultural and use based information is still very much tied to situated, social, and direct experiences with plants and animals.

Chapter Six will provide an overall summary of research findings and how they relate to the research propositions and expectations set forth at the beginning of this manuscript. The chapter will explain the anthropological contributions of this work and how this research can inform theory. Chapter Six will also discuss the benefits that this research is providing to the local community and will describe the broader applications it has on conservation and environmental education in the region.

Chapter 6

Conclusions

Figure 6.1 Cactus fruit harvesting as the rain clouds form over Alamo Canyon in the OPNM. The festival of *ha:san ba:k masad* marks the conclusion of the old and the beginning of the new calendar year for the O'odham.

This dissertation has identified ethnobiological knowledge distribution and described local processes of knowledge acquisition among Anglo, Hispanic, and O'odham children and adults in Ajo, Arizona. One of the aims has been to illuminate the generational changes that have taken place regarding transmission and acquisition of cultural knowledge. This final chapter will present a summary of the overall research findings. I will briefly discuss the anthropological contributions of this work and how this

research can inform theory. I will also discuss the benefits that this research is providing to the local community as well as broader applications it has on conservation and environmental education in the region.

Summary of Findings

Children and adults differ in their knowledge and methods for learning about desert plants and animals. Results indicate patterned variation between cohorts with respect to how information is learned and sought out. Knowledge itself varies according to quantity and quality or content. Adults demonstrate more naming and recognition abilities than do children. The content of their knowledge differs in that they know a greater number of local or native plants and animals than children, and have retained more species specific names for plants and animals. Children's plant and animal knowledge is more limited than adults, containing a greater number of non-native and plants and animals named at the generic or life form level.

Both generations tend to name and recognize similar plants and animals—animals that are considered dangerous, and large, spiny plants. This supports the proposition originally set forth in the research as well as previous findings (O'Brien 2005). Also as was proposed, there are specific plants and animals that are not recognized by the younger generation in this study, but are still recognized by adults. These animal species tend to be nocturnal and threatened or endangered, the commonality being that they are not often seen on the landscape. Plants which are not recognized or named by both adults and children are typically small. They also tend to be plants that were once held as culturally important for their spiritual or medicinal uses.

The proposition that adults would recognize and correctly identify a greater number of plant and animal referents than children is supported by the findings of this study. The proposition that recognition scores would vary within each cohort according to demographic characteristics such as age, gender, ethnicity, years of residence, contact with grandparents, and languages spoken, and by behavioral characteristics such as methods of learning and free time activities was only partially upheld. Recognition scores increase significantly with age, location of home, park visitation, and hunting in the children's cohort and ethnicity in the adult cohort. Surprisingly, naming and recognition abilities are not significantly associated with how the knowledge was acquired. However, children who participate in experience-based activities such as hunting are better able to identify wild foods, know species-specific names, and have more knowledge than others in their cohort about the ecology and uses of plants and animals.

The data supports the expectation that children and adults would report different learning methods and experiences in nature. Adults reported having learned as children most often through situated learning experiences with parents and grandparents. However, the theory that cultural knowledge would be distributed according to the context in which learning first took place was not supported. Nevertheless, adults who reported experiential learning throughout their lifetime demonstrate a different quality and content of knowledge, with the ability to specifically name, recognize, and talk about cultural uses and beliefs about referents.

Contributions to Anthropological Theory

This dissertation addresses a fundamental issue in cultural anthropology which is to describe and explain the process of cultural change, and to search for patterns that reflect the progression and transformation of cultural knowledge across human populations. Anthropologists have long been interested in explaining the process of culture change, and realizing that culture is learned and then taught to others has lead to questions about the dynamic properties of cultural reproduction. Namely, how culture is transmitted, transformed, lost, or changed. Environmental anthropologists have looked more specifically at how these changes affect human-environment relationships and cultural knowledge systems linked to plants, animals, and places.

The findings indicate that the younger cohort reported learning and seeking answers from the media, meaning books and television, and internet more than adults, and this shift is reflected in their naming a greater number of non-native plants and animals than their elders. As the means by which culture is transmitted shifts from that of place-based stories to technology that allows a more global view of the world, it will be interesting to see its effect on knowledge acquisition and transformation. More studies are needed that focus on the increasing presence of media-based learning and technology in children's lives and the role this plays in reproducing and/or transforming local knowledge. Questions of primary concern are: Has an increase in media and technology in the lives of children decreased their time spent in outdoor environments? How does this affect the content of what they know about plants and animals? Without memory tied to experience and place, does lack of exposure also have an effect on their motivations

for learning about nature? And, if they are indeed losing cultural knowledge about living things, is something being gained to replace it?

One of the outcomes of this research is that I have identified specific species and skills that appear to be lacking in the younger generation of study participants. For example, the younger cohort in this study have a very limited amount of knowledge about wild foods and nocturnal and threatened or endangered animals which is in sharp contrast to the older generation. One could infer from this finding that this is due to a lack of experience or exposure i.e. because there is no longer the necessity to gather wild foods they do not know about them or because they rarely see a desert pronghorn, they are unable to recognize one. It is tempting to state that there is certain knowledge about nature that is being "lost" in younger generations. However, without longitudinal data I cannot make a valid argument. However, these research results will provide baseline data for conducting future longitudinal studies in the region that would allow for measurement of the loss of cultural knowledge among multiple generations.

Research results from this dissertation will contribute to sociocultural learning theories in this area through the identification of particular interactions and community practices such as the social ritual of hunting that are associated with acquisition of ethnobiological knowledge. Research in educational anthropology focuses on the acquisition and transmission of knowledge by emphasizing the importance of the social context in which learning takes place (Brown 1996, Lave and Wenger 1991, Rogoff 1990, 2003, Tripp 1996). These studies theorize that identifying the cultural, community practices that situate human cognition through direct participation and observation in natural settings is critical to understanding the social process of human development and

cognition. However, a still understudied area of anthropology is ethnography of the lives of children. By studying the social networks and relations of children we will begin to understand the role of community practices in knowledge transfer and be better able to model and perhaps predict the dynamics of cultural knowledge.

Cultural transmission studies have been conducted in various locations with a diverse group of cultures but very few have focused on the rural United States (Atran 2001, Boster 1987, Ellen and Harris 2000, Ross 2002, Ruddle 1993, Wyndham 2002, Zarger 2002). Ajo, the location of this study, is reflective of many rural communities who are experiencing cultural exchange from a growing multi-ethnic population. The research findings from this dissertation may be used in cross cultural comparisons to help explain or predict the process of knowledge variation or change in other locations.

Many anthropologists interested in acquisition, transmission, and retention of TEK are interested in its social reproduction, focusing on identifying the key transmitters. In general, the findings have been that younger generations either know less than their elders or know a different type of information such as names rather than uses or skills. The focal questions now become, why is this change occurring? Researchers have posited a number of factors including loss of motivation, changes in exposure or employment, attitudes of older generations, social breakdown of extended families, and environmental changes. So, now that we know that change is occurring, further inquiry is needed in order to explain the complexities of *why* this is happening. We as researchers need to go beyond the notion that there is simply a lack of interest or culture change leading to a breakdown of knowledge systems. Future studies would benefit from such questions as: How does accessibility to natural resources affect motivations for learning? What is the

role of institutionalized knowledge in the cultural production of knowledge? How do social networks contribute to knowledge reproduction particularly in the lives of children?

Toledo has called for researchers that are engaging in acquisition and transmission studies to use systematic methods to allow for cross cultural comparisons and theory building (Toledo 2002). This dissertation utilizes an innovative means of eliciting names and information about referents through the use of video. Such a methods is practical and cost-effective in many situations where plant vouchers or trails or animal specimens are not available or possible. The methods described in this research could be replicated and applied elsewhere in order to test naming competence and recognition abilities in other populations.

Finally, this dissertation builds on previous research conducted in the Sonoran Desert and will add to the extensive work of anthropologists, biologists, and botanists who have conducted ethnographic and ethnobotanical research in the desert southwest (Castetter and Underhill 1935, Dobyns 1972, Fontana and Schaefer 1981, Nabhan 1982, Rea 1997, 1998, Underhill 1976, 1978, 1979). The work of these individuals has been an inspiration for me and it is my hope that this dissertation and the questions that evolve from it will underscore the importance of developing innovative resources to maintain the biocultural diversity of this region.

Applications to Biocultural Education and Conservation

Children's apparent disconnect from nature is linked to many of the social and biological problems plaguing younger generations today. Namely attention-deficit disorder, hyperactivity, obesity, and learning difficulties. This has become a national concern in the United States and educators have been struggling with ways in which to engage children and youth in nature-based learning. One movement has been to utilize our national parks as outdoor classrooms for learning. Interpretation and education has become a focal concern for National Park Service (NPS) managers who have recently outlined a vision of the national park system as a significant resource for learning about the historical and contemporary connections between nature and human culture. My research is currently being used by park service staff to help them reach these goals by producing outreach materials, and implementing creative, hands-on educational opportunities that link nature and human culture.

For example, the findings that the younger cohort in this study are still learning primarily from people and mostly people who are older could inform educational programs at the park. A program that has been successful in other places is to bring elders into classrooms or have them lead discussions or be trail guides for school programs. I attended one such field trip to Organ Pipe with children from the reservation. An elder accompanied us and spoke to the students about historical landmarks and plant use. Involving the parents and grandparents of students in biocultural education not only helps convey information to the younger generation but also keeps the parents and grandparents engaged in their culture's reproduction of knowledge.

One of the challenges for NPS staff has been the difficulty in creating materials that can speak the diverse communities surrounding the Organ Pipe Cactus National Monument. This dissertation has provided a baseline of data on local children's environmental knowledge which park staff and will serve as a foundation on which to build future curriculum materials to disseminate to local schools and use in ORPI monitoring and education programs.

The importance of providing children with hands-on learning experiences that involve plants and creatures cannot be overemphasized. Today's children will inherit all of the beauty and awe of these resources as well as the problems we have created through overdevelopment, pollution, and mismanagement. By involving children in our efforts to preserve the biocultural diversity of such places as the Sonoran Desert we invest in their future.

Community Benefits

This project has contributed several benefits to the community of Ajo. First, it provided ethnographic research training and interviewing skills for four local collaborators which will hopefully be useful to them in their future studies or employment. Another direct benefit to the community is a portable electronic library using the video clips from the recognition test and cultural information that participants provided for each plant and animal referent. This electronic library will be distributed to local schools, parks, and public libraries on a disk for use in science and biocultural education programs.

Many benefits of this research are indirect and include community participation in the project design and implementation. One of the reasons for success of this research has been an open communication with community members via regular presentations and updates at the Ajo Unified School District and the Curley School. I also used the *Ajo Copper News* newspaper on a regular basis in order to explain the goals and progression of the project and to help explain to community members the purpose and methods of ethnographic research. Transparency through open communication and regular updates on research encourages accountability such as when you will deliver results as well as increasing the legitimacy of the project to the community (see Appendix H).

One of the ways that I was able to engage community members in the project was to make the interview process a learning opportunity for both the researchers and the participants. For example, myself and my research team encouraged student participants talk to their parents about desert plants and animals and in particular what they learned through the interview process. Adults in Ajo, most of whom were parents to the student participants, were consulted on the most salient plants and animals to include in the study as well as their perceptions on why children were losing knowledge and what was most important for them to know. We also organized a field trip to the park as a way to thank community members for their participation in the project and invited parents of student participants to attend as well. This was the first of its kind field trip for the 80 Ajo students that attended, many of whom had never visited this park.

Figure 6.2 Myself (left) and a group of students during our field trip to OPNM.

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As children acquire more and more information in abstract ways, they are losing their ability to learn by doing or discovering and are rather being trained to simply absorb information. The problem of the younger generation's disconnect with the natural world has far reaching effects that go beyond the anthropological inquiry of this study. How this phenomenon will affect the abilities and creativity of younger generations is unknown. However, through research inquiry and educational programs that emphasize hands-on learning, we can provide more experiences that lead to a greater understanding of the desert's diversity of plants and animals. Because, without direct experiences that build positive memories of living things and landscapes, the next generation will not teach their own kids, and thus this cultural knowledge and appreciation for the natural world will be lost forever.

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Appendix A: Plants and Animals for Video Elicitation

Common Name	Scientific Name	O'odham Name	Spanish Name
agave	*Agave* spp.	a'o't	agave
beargrass	*Nolina microcarpa*	moho	palmilla
brittlebrush	*Encelia farinsa*	tuhar	incienso
cholla	*Opuntia fulgida*	ha:nam	cholla
bird pepper	*Capsicum frutescens*	tcirtipin	chiltepin
creosote, greasewood	*Larrea tridentata*	ségai	hediondilla
sacred datura	*Datura* spp.	kótdop	datura
devil's claw	*Proboscidea parviflora*	ihu'k	uña de gato
ironwood	*Olneya tesota*	ho'idkam	palo fierro
jojoba	*Simmondsia chinensis*	hohowai	jojoba
mesquite	*Prosopis* spp.	kui	mesquite
mormon tea	*Ephedra* spp.	kawaiisu	popotillo
ocotillo	*Fouquieria splendens*	mélhoki	ocotillo
organ pipe cactus	*Stenocereus thurberi*	tcutcuis	pitahaya dulce
foothills palo verde	*Cerceilium microphyllum*	ko'okmadk	palo verde
prickly pear	*Opuntia engelmannii*	nohwi	nopal
saguaro	*Carnegiea gigantea*	ha:canyi	sahuaro
buckhorn cholla	*Opuntia acanthocarpa*	hanam	cholla
tepary bean	*Phaseolus actuifolius*	bawi	teparia
wolf berry, squaw berry	*Lycium* spp.	kohm	tomatillo

Common Name	Scientific Name	O'odham Name	Spanish Name
Anna's hummingbird	*Calypte anna*	viik	colibri, chuparrosa
big horn sheep	*Ovis canadensis nelsoni*	kahwul	borego cimarrón
bobcat	*Felis rufus*	gevvho	gato montes
lesser long-nosed bat	*Leptonycteris curasoae*	nanakmor	murcielago
desert cottontail	*Sylvilagus auduboni*	to: pi	conejo
coyote	*Canis latrans*	bán	coyote
desert pronghorn	*Antilocapra americana*	kuhwith	berrendo
desert tortoise	*Gopherus agassizii*	komaktcï't	tortuga
elf owl	*Micrathene whitneyi*	chukoch	tecolote, buho
Gambel quail,	*Callipepla gambelii*	kakaitcu	codorniz de Gambel
gila monster	*Heloderma suspectum*	cheadagi	monstruo de gila
horned toad	*Phrynosoma* spp.	chemamagi	cachorón
collared peccary, javelina	*Peccary angulatus*	kohji	cochi javelín
black-tailed jackrabbit,	*Lepus californicus*	tcu'k tcu:wi	liebre
mountain lion	*Felis concolor*	saimistar	león, puma
mourning dove	*Zenaidura macroura*	hohhi	paloma triste, hiulota
white tail deer	*Odocoileus virginianus*	a'ak	venado cola blanca
raven	*Corvus cryptoleucus*	hawani	cuervo común
road runner	*Geococcyx californianus*	tachai	correcaminos
round tailed ground squirrel	*Spermophilus tereticaudus*	ci:ri'k	juancito
bark scorpion	*Centruroides sculpturatus*	nakshel	alacrán, escorpión
desert spadefoot toad	*Scaphiopus couchi*	babath	sapo con espuelas
tarantula	*Aphonopelma chalcodes*	hiañ	tarantula
turkey vulture, buzzard	*Cathartes aura*	nui	zopolote, aura
western diamondback rattlesnake	*Crotalus atrox*	nehbig	víbora de cascabel

Appendix B
Frequency Recognition of Plants and Animals
Tables 4.3 and 4.4

Table 4.3 Recognition Frequencies Plants

				Children (n=110)	Adults (n=19)
Common Name	**Scientific Name**	**O'odham Name**	**Spanish Name**	**Specific (%)**	**Specific (%)**
agave	*Agave* spp.	a'o't	agave	14%	68%
beargrass	*Nolina microcarpa*	moho	palmilla	1%	26%
brittlebrush	*Encelia farinsa*	tuhar	incienso	5%	26%
cholla	*Opuntia fulgida*	ha:nam	cholla	2%	52%
bird pepper	*Capsicum frutescens*	tcirtipin	chiltepin	12%	63%
creosote, greasewood	*Larrea tridentata*	ségai	hediondilla	29%	90%
sacred datura	*Datura* spp.	kótdop	datura	1%	26%
devil's claw	*Proboscidea parviflora*	ihu'k	uña de gato	17%	68%
ironwood	*Olneya tesota*	ho'idkam	palo fierro	5%	84%
jojoba	*Simmondsia chinensis*	hohowai	jojoba	1%	37%
mesquite	*Prosopis* spp.	kui	mesquite	40%	84%
mormon tea	*Ephedra* spp.	kawaiisu	popotillo	0%	11%
ocotillo	*Fouquieria splendens*	mélhoki	ocotillo	39%	90%
organ pipe cactus	*Stenocereus thurberi*	tcutcuis	pitahaya dulce	46%	90%
foothills palo verde	*Cerceilium microphyllum*	ko'okmadk	palo verde	42%	100%
prickly pear	*Opuntia engelmannii*	nohwi	nopal	53%	100%
saguaro	*Carnegiea gigantea*	ha:canyi	sahuaro	78%	100%
buckhorn cholla	*Opuntia acanthocarpa*	hanam	cholla	2%	53%
tepary bean	*Phaseolus actuifolius*	bawi	teparia	1%	11%
wolf berry, squaw berry	*Lycium* spp.	kohm	tomatillo	2%	37%

Table 4.4 Recognition Frequencies Animals

Animals				Children (n=110)	Adults (n=19)
Common Name	**Scientific Name**	**O'odham Name**	**Spanish Name**	**Specific (%)**	**Specific (%)**
Anna's hummingbird	*Calypte anna*	viik	colibri, chuparrosa	16%	68%
big horn sheep	*Ovis canadensis nelsoni*	kahwul	borego cimarrón	35%	95%
bobcat	*Felis rufus*	gevvho	gato montes	79%	90%
lesser long-nosed bat	*Leptonycteris curasoae*	nanakmor	murcielago	6%	21%
desert cottontail	*Sylvilagus auduboni*	to: pi	conejo	35%	84%
coyote	*Canis latrans*	bán	coyote	93%	100%
desert pronghorn	*Antilocapra americana*	kuhwith	berrendo	18%	47%
desert tortoise	*Gopherus agassizii*	komaktcï't	tortuga	55%	84%
elf owl	*Micrathene whitneyi*	chukoch	tecolote, buho	13%	37%
Gambel quail,	*Callipepla gambelii*	kakaitcu	codorniz de Gambel	21%	90%
gila monster	*Heloderma suspectum*	cheadagi	monstruo de gila	84%	90%
horned toad	*Phrynosoma* spp.	chemamagi	cachorón	66%	100%
collared peccary, javelina	*Peccary angulatus*	kohji	cochi javelín	94%	95%
black-tailed jackrabbit,	*Lepus californicus*	tcu'k tcu:wi	liebre	83%	95%
mountain lion	*Felis concolor*	saimistar	león, puma	80%	79%
mourning dove	*Zenaidura macroura*	hohhi	paloma triste, hiulota	29%	63%
white tail deer	*Odocoileus virginianus*	a'ak	venado cola blanca	22%	79%
raven	*Corvus cryptoleucus*	hawani	cuervo común	41%	84%
road runner	*Geococcyx californianus*	tachai	correcaminos	95%	100%
round tailed ground squirrel	*Spermophilus tereticaudus*	ci:ri'k	juancito	26%	58%
bark scorpion	*Centruroides sculpturatus*	nakshel	alacrán, escorpión	96%	100%
desert spadefoot toad	*Scaphiopus couchi*	babath	sapo con espuelas	12%	21%
tarantula	*Aphonopelma chalcodes*	hiañ	tarantula	99%	100%
turkey vulture, buzzard	*Cathartes aura*	nui	zopolote, aura	69%	95%
western diamondback rattlesnake	*Crotalus atrox*	nehbig	víbora de cascabel	93%	95%

Appendix C: Recognition Scores by Demographics

Table 4.5 Recognition Scores (means and breakouts by demographics)

	Children (n=110)	Adults (n=19)
Gender	**Mean Specifics**	**Mean Specifics**
Female	17.18	34.00
Male	17.71	30.38
Ethnicity		
Anglo	17.90	32.00
Mexican	17.42	28.80
Tohono O'odham	16.75	35.00
Age		
12	14.90	
13	14.72	
14	17.86	
15	18.70	
16	18.73	
17	19.89	
20	20.00	
31 to 50		29.89
51 to 70		32.00
71 to 99		30.00
Years in region		
1 to 5 years	16.28	
6 to 11 years	19.04	
12 or more	17.20	
1 to 10 years		28.33
11 to 30 years		30.00
31 to 49 years		30.00
50+ years		32.56
Location of home		
In town	17.03	30.94
out of town	19.17	31.00
Grandparent in home		31.00
yes	15.75	36.55
no	17.75	30.88

Appendix D: Permission Forms

I agree to allow my child, _____, to take part in a research study titled, "The Ethnoecology of Sonoran Desert Plants and Animals", which is being conducted by Colleen Marie O'Brien, from the Anthropology Department at the University of Georgia (706) 542-3922 under the direction of Dr. Brent Berlin, Professor of Anthropology (706) 542-1452.

The reason for the study is to identify how people learn about Sonoran Desert plants and animals. What adults know and how they learned about plants and animals will be compared with what children know and learn in order to identify differences between the two generations. Children who take part may learn about Sonoran plants and animals. The researcher also hopes to create new educational activities and curriculum at Organ Pipe Cactus National Park that may help other children learn about the cultural connection between people and plants and animals of the Sonoran Desert. If I allow my child to take part, my child will be asked to talk about time spent with a grandparent or elder family member. My child will also be shown a series of short videos of animals and asked to identify and talk about them. The interviews are expected to last approximately 30 minutes. The research is not expected to cause any harm or discomfort. My child can quit at any time. My child's grade will not be affected if my child decides to stop taking part. Any information collected about my child will be held confidential unless otherwise required by law. My child's identity will be coded, and all data will be kept in a secured location. Any information that is obtained in connection with this will remain confidential unless required by law. I do not have to allow my child to be in this study if I do not want to. My child can stop taking part at any time without giving any reason, and without penalty. I can ask to have the information related to my child returned to me, removed from the research records, or destroyed**.**

Audio and video recordings that include the voice and image of my child can be used in this research. I understand that audio and video recordings will be analyzed by investigators and maintained indefinitely only for the purpose of research and education. There is a possibility that the recordings with my child's voice and image could be used to teach or present at conferences or may appear on the National Park Service website.

Yes_____ No_____ (please initial)

I will answer any questions about the research, now or during the course of the project, and can be reached by telephone at: (520) 387-6717 or (520) 834-3063. I understand the study procedures described above. My questions have been answered to my satisfaction, and I agree to allow my child to take part in this study.

_____ _____

Name of Researcher Signature

Date

_____ _____

Name of Parent or Guardian **Signature**

Date

Telephone: _____

Email: _____

Additional questions or problems regarding your child's rights as a research participant should be addressed to The Chairperson, Institutional Review Board, University of Georgia, 612 Boyd Graduate Studies Research Center, Athens, Georgia 30602-7411; Telephone (706) 542-3199; E-Mail Address IRB@uga.edu

Formato de permiso por los adultos

Yo _____ estoy de acuerdo participar en el estudio de investigación titulado **"**La Etnoecologia de las plantas y los animales del Desierto de Sonora**"** que es realizado por Colleen Marie O'Brien del departamento de Antrolopogía de la Universidad de Georgia (706) 542-3922 bajo la dirección del doctor Brent Berlin, del departamento de Antrolopogía, la Universidad de Georgia (706) 542-3922.

El motivo por la investigación es para identificar la importancía de las interacciones sociales y los contactos intergeneracionales para aprender información cultural sobre las plantas y los animales del Desierto de Sonora. Vamos a comparar la información que los abuelos saben y como aprendieron con la de los niños para identificar las diferencias entre las dos generaciones. Los niños que participar en el proyecto aprenderían sobre las plantas y los animales del Desierto de Sonora. La investigadora espera inventar nuevas actividades educativas y planes de estudio en el Parque Organ Pipe Cactus National Monument. Sí yo participo en este proyecto, yo responderá sobre el tiempo que él pasa con mis nietos o con personas menores. Entonces, yo responderá preguntas para identificar y hablar sobre las plantas durante un camino andando, un camino de cien pies al parque con la investigadora o con un ayudante adulto. También, yo mirará videos cortos de los animales y hablará sobre los animales. Las entrevistas durarán una hora, más o menos. No se espera ninguna incomodidad o molestia en la participación. Yo puedo dejar de participar en la investigación en cualquier momento. Yo no está forzado/a a ser parte de este estudio. Yo puedo dejar de participar en cualquier momento sin dar explicación, y sin ninguna penalidad. Yo puedo solicitar que toda la información referente a mi sea retirada de los archivos de la investigación, destruida, o devuelta a mí.

La información obtenida a través de este estudio que pueda ser identificada específicamente con yo confidencial y será expuesta sólo con mi autorización o si es requerida por la ley. Yo entiendo que para efectos de publicación de todo lo escrito se usará seudónimos, que la información será usada sólo para propósitos analíticos y permanecerá confidencial. Pueden ser hechas transcripciones de las grabaciones de las entrevistas, dejando fuera información identificadora. Yo entiendo que las grabaciones de audio o video serán analizadas por los investigadores, y mantenidas indefinidamente sólo para propósitos investigativos y educativos. Hay la posibilidad de que grabaciones de audio con mi voz d puedan ser usadas para enseñanza o para presentaciones en conferencias. Esto está sujeto a mi autorización expresa, dado a continuación.

Grabaciones de audio o video que incluyen mi voz pueden ser usadas en reuniones de investigación.

Sí_____ No_____
[Coloque sus iniciales]

La investigadora contestará cualquiera otra pregunta acerca de la investigación, ahora o durante el curso del proyecto, y puede ser contactado por teléfono al 520-834-3063 (cel), 520-387-8945 (casa) o por correo electrónico en esta dirección cobrien@uga.edu.Yo entiendo los procedimientos del estudio descritos arriba. Mis preguntas han sido contestadas a satisfacción, y estoy de acuerdo participar en este estudio. Yo he recibido una copia de este formato para mis archivos.

_____

Nombre del la investigadora _____ _____

_____

número del teléfono Firma de la Investigadora Fecha

_____

correo electrónico

_____ _____ _____

Nombre del participante Firma del Padre/Encargado Fecha

Por favor, firme ambas copias, guarde una para usted y devuelva la otra a la investigadora.

Preguntas adicionales o problemas respecto de los derechos de su hijo/a como participante en una investigación deberán ser dirigidos al Director del IRB, Oficina de Participantes Humanos, Universidad de Georgia, 612 Boyd Graduate Studies Center, Athens, GA, 30602-7411; teléfono (706) 542-3199; correo electrónico IRB@uga.edu.

Appendix E: Interview Protocol

Code: _____

Name all of the animals that you can think of:

Name all of the plants that you can think of:

Name all of the things that you can eat in the desert:

Social Interactions

Name the 5 people who you usually spend the most time with?

What activities do you do when you are together?

What do you usually do in your free time?

Have you ever visited a park? Which ones?

How do you usually learn about plants and animals?

If you had a question about the Sonoran Desert how would you find out the answer?

Demographics

What is your age?

How long have you lived in Ajo? Arizona?

Do you live in town or outside of town (in a rural area or farm)?

Who lives in your household?

What languages do you speak/read/write?

What is the first language that you learned?

What language do you speak with your brothers/sisters?

What language do you speak with your parents?

What language do you speak with your grandparents?

What language do you speak with your friends?

Appendix F: Questionnaire Form

ID	Name	English/Spanish/TO Name	Where have you seen this?
1	Anna's hummingbird		
2	lesser-longnosed bat		
3	big horn sheep		
4	Bobcat		
5	desert cottontail		
6	Coyote		
7	desert tortoise		
8	elf owl		
9	Gambel quail		
10	gila monster		
11	horned toad		
12	Jackrabbit		
13	Javelina		
14	mountain lion		
15	mourning dove		
16	Raven		
17	road runner		
18	ground squirrel		
19	bark scorpion		
20	desert pronghorn		
21	desert spadefoot		
22	Tarantula		
23	turkey vulture, buzzard		
24	Rattlesnake		
25	white tailed deer		

ID	Name	English/Spanish/TO Name	Where have you seen this?
26	Agave		
27	Beargrass		
28	chiltepin pepper		
29	Brittlebrush		
30	chainfruit cholla		
31	creosote bush		
32	sacred datura		
33	devil's claw		
34	ironwood		
35	Jojoba		
36	Mesquite		
37	mormon tea		
38	Ocotillo		
39	organ pipe cactus		
40	foothills palo verde		
41	prickly pear		
42	Saguaro		
43	tepary bean		
44	wolf berry		

Appendix G: Organ Pipe Cactus National Monument Fieldtrip Permission Slip

As part of the ongoing science project on Sonoran Desert plants and animals, students who participated in the research interviews last month have been invited on a trip to the Organ Pipe Cactus National Monument on **Friday December 8th**. During their visit, students will receive an introduction to the park and its resources by park ranger Andy Fisher, walk the 1.5 mile Desert View Nature Trail, and participate in a park scavenger hunt of desert plants and animals. The fieldtrip will be a fun experience for the students, but it will also help them to learn about Sonoran Desert plants and animals by seeing some of them in their natural environment. Students will depart by 9am by bus to the monument. They will be served lunch while at the monument, and will return to school by 2pm.

Yes, _____ has my permission as parent or guardian to attend the Organ Pipe Cactus National Monument field trip.

_____ _____
Signature parent or guardian Date

_____
Phone Number

While at the monument, photos or video of the students may be taken and could appear on the National Park Service website or in other teaching materials.

_____ Yes, you have permission to include my child in video or photographs

_____ No, you do not have my permission to include my child in video or photographs

We will need parent volunteers to attend the fieldtrip as chaperones. Please indicate below if you are willing to attend as a chaperone. You will be contacted to discuss the details of the trip.

_____ Yes, I can attend as a chaperone

Appendix H: Press Coverage

Ph.D. Student Wants to Know What You Know

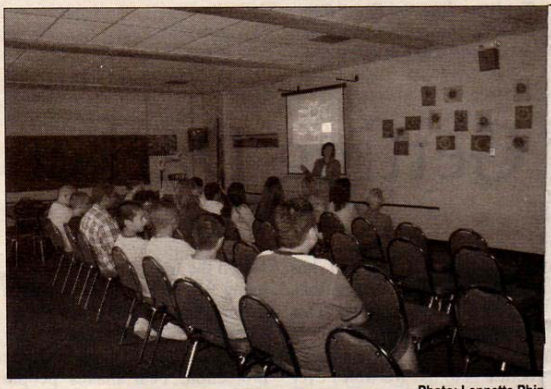


Photo: Lannette Phip

Colleen O'Brien, Ph.D. Candidate, Department of Anthropology at the University of Georgia gav brief presentation about her research to 7th and 8th grade students at the Ajo School last week.

Lannette Phipps
Ajo Corridor Times

What do you know about the Sonoran Desert and its inhabitants and plants? And where did you learn it? From a book? Television? Your Grandfather? Mother? This is what Colleen O'Brien is trying to find out by conducting a series of interviews with children and adults from Ajo and surrounding areas.

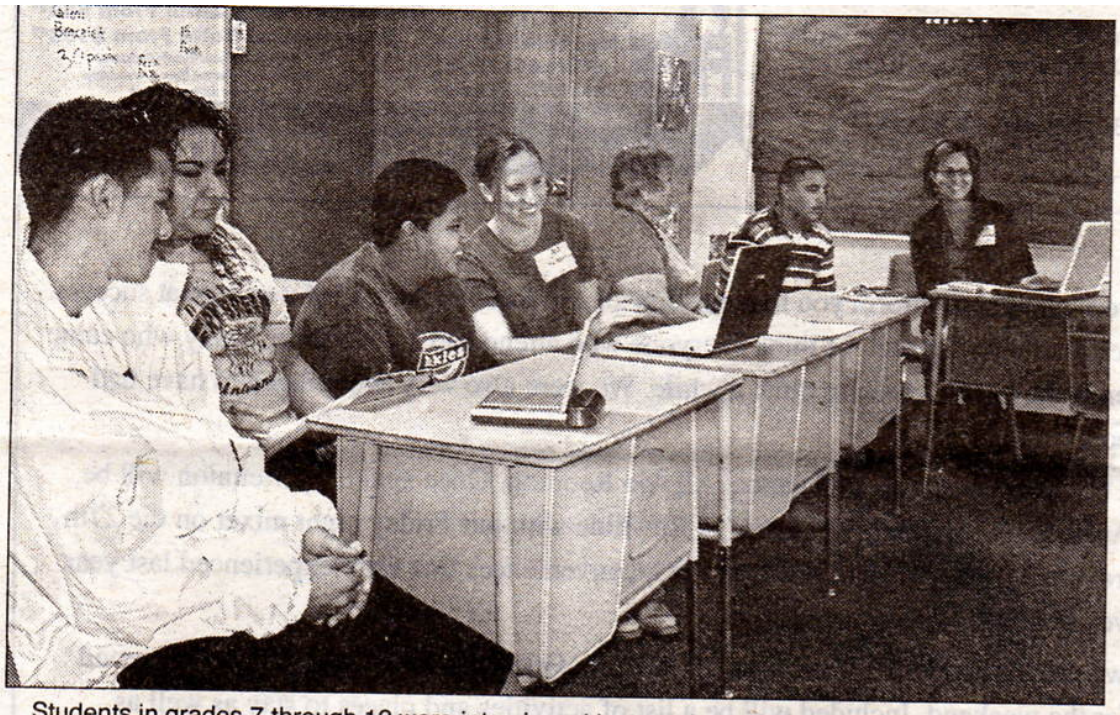
Colleen is a Ph.D. candidate from the Department of Anthropology at the University of Georgia who has been in Ajo since January conducting research. Research always sounds like such a "trigger" word. I picture (mostly) square men in long white coats with pocket protectors and eyeglasses (not that there's anything wrong with eyeglasses, I am wearing a pair myself right now as I make all these typos) with clipboards, data sheets and maybe a lab animal or two. Colleen is anything but, though I suspect she may have a pair of glasses hidden in her really cool leather satchel.

Last week she gave a presentation to 7th and 8th grade school kids here in Ajo. The kids filed in one by one, sat down and listened with rapt attention as Colleen explained her purpose. In a nutshell, omitting all of the scholarly jargon, she wants to know what they know about the desert and where they learned it. Her interviews are not just limited to children, she is also asking adults the same questions. But, on this day, she was addressing the 7th and 8th graders, some of who knew a lot about the desert and some who had even been to Georgia! If the kids are permitted – signed permission slips are needed from their parents – they will sit down for a 30-minute interview, where they will share what they know about the Sonoran Desert. Make a list of all of the animals you can think of. Make a list of all of the plants. Make a list of all of the things that you can eat in the desert. Those are 3 of the questions they are asked to answer. Then they are shov video clips of desert plants a animals and asked to ident them. What all of this leads to is finding out what they kn and how they learned it. T knowledge, that she will sh with the Organ Pipe Cac National Monument, will h them create educational to – in a nutshell. Without knowing what kids already know – it's pretty hard to create specific learning tools. There is…more to the story…as they say, but I plan to provide you with plenty of reading material about Colleen and her research in future issues – it really is fascinating and she is an extremely nice and likeable person. Anyone who would want to sit down and interview 200 people on a one-on-one basis (especially kids) has the patience of a Saint - in my opinion, of course.

I must say, all of the kids were very well behaved and gave Colleen their full attention. And most seemed very interested – especially when there was mention of a field trip to Organ Pipe for those who participated in the survey. A day away from school – *woohoo*! Hopefully, parents will allow their children to be interviewed and will also want to be interviewed themselves. It is non-intrusive and there are no right or wrong answers – she is simply gathering information. For those parents who are aware of this project, be sure to get your kid's permission slips in by Friday. For those of you who are not, contact the school and ask about participating in Colleen's research.

Colleen said that everyone at the Ajo School, and especially Principal Don German, has been extremely helpful and accommodating – she can't thank them enough.

If you see Colleen wandering around town, say hello and welcome her to Ajo – she might even want to know what you know about the desert and where you learned it. And stay tuned for more articles and 'scholarly jargon' that I am surely not qualified to write about!



Students in grades 7 through 12 were interviewed last week to find out what they know about the Sonoran Desert and how they learn about it. Colleen O'Brien, at far right, is conducting research for her dissertation in environmental and ecological anthropology at the University of Georgia. During one session, Jordan Lopez was interviewed by research associate Griselda Sandoval, Marcos Rangel was interviewed by research associate Jessica Piekielek, and Hector Campa was interviewed by O'Brien and research associate Faye Miller.

Students are asked to name animals, plants, and desert foods. They are shown video clips of 45 Sonoran Desert plants and animals and asked to name them and talk about them. Students are also asked about their interests and hobbies and how they learn about the desert.

"When the students first sit down with the interviewer they are shy, but after they begin to watch the plant and animal videos they open up, tell stories, and realize they know more than they thought," said O'Brien. "One benefit of one-on-one interviews is that students learn the correct names, uses, and other ecological information about desert plants and animals at the same time."

Research results will be made available to the school, Organ Pipe Cactus National Monument, and other agencies and organizations to assist them with planning their education and outreach to the culturally diverse group of students living in and around Ajo, according to O'Brien.

The next stage of the project involves interviewing parents and grandparents of student participants in order to find out generational differences in knowledge and learning about the desert. O'Brien's research is funded by the Canon National Parks Science Scholarship and the National Science Foundation.

Ajo Kids Participate in Field Trip to OPCNM

So, which is the plant that smells like rain? How do humans use the ocotillo? These are some of the questions that 7th and 8th graders from the Ajo Unified School District answered last Friday, December 8th, when they visited the Organ Pipe Cactus National Monument for an educational field trip to learn more about Sonoran Desert plants and animals. The field trip was attended by students who have participated in an ongoing research project on local knowledge about the Sonoran Desert which is being conducted by Ajo resident Colleen O'Brien through the University of Georgia Department of Anthropology.

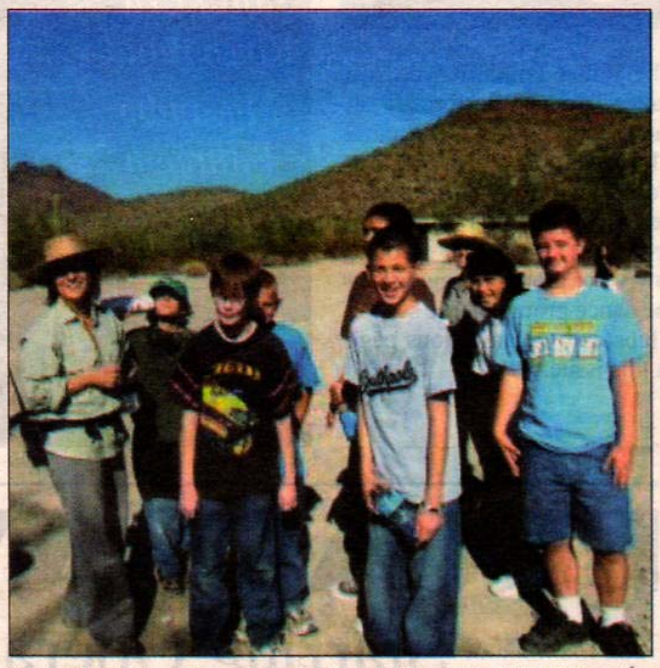
While visiting the park, students, parents, and teachers were led on a 1.5 mile hike along the Desert View Nature Trail by park ranger Andy Fisher and park volunteers Karen Johnson, Sharon Genaux, Bruce Secker, Mary Ann Guggemos, and Colleen O'Brien. Along the walk, students saw about a dozen species of cactus, learned about cultural uses for desert plants, and even had a moment to enjoy the silence of the desert and report on what they could hear. After a picnic lunch, students were once again broken into groups for a competitive scavenger hunt to locate and answer questions about the plants that they learned about

Left to right: Elizabeth Armenta, Laymi Raya, Selena Juarez, and Marilyn Acosta enjoy a lunch break after the hike.

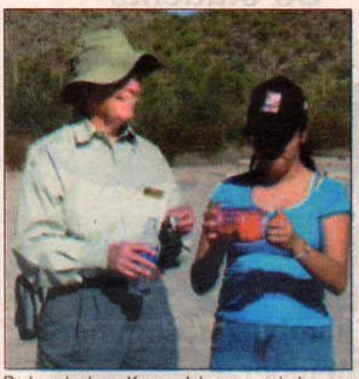
Parent Chaperone Sarah Quail, teacher Julie Tiel, and Park volunteer Mary Ann Guggemos rest after the 1.5 mile hike.

the students, not the trail guides, who were responsible for leading the groups to designated plants and then answering questions such as "Name all of the animals that may live in a hole in the saguaro?"

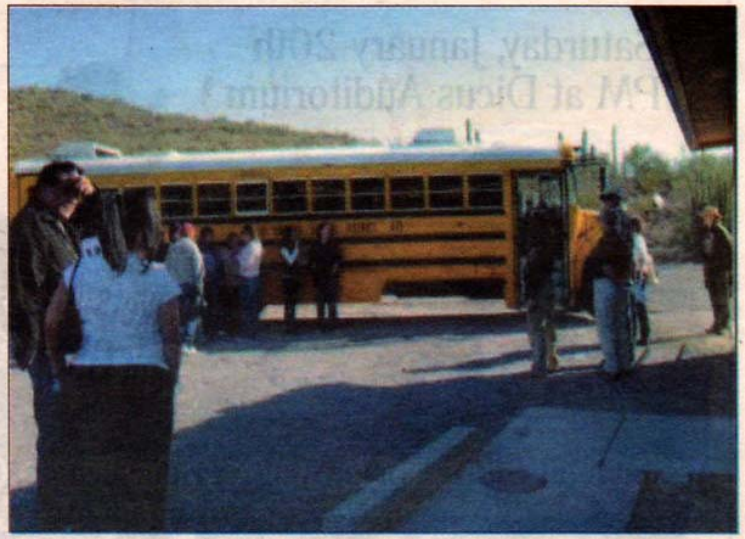
"The fieldtrip allowed students the opportunity to utilize our national parks as a way to learn outside of the classroom and to experience the sights, sounds, touch, and smells of the desert" said O'Brien. Some students walked in the desert for the first time while other students who already know a lot about the desert learned even more and had the opportunity to share their knowledge with the group. Colleen extends her thanks to the staff of Organ Pipe Cactus National Monument for helping to organize and facilitate the trip, all of the parent and teacher chaperones, and to the attentive students who have participated in her project. Colleen's research, which will be made available to the community upon completion, is financed by the Canon National Parks Science Scholarship and the National Science Foundation.



Left: Colleen O'Brien, Roman Sonora, Shane Poole, Jacob Miller, Jordan Valdez, Eddie Padres, Andy Fisher, Devon Castro, and Daniel Strickland are all smiles after placing first in the scavenger hunt.



Park volunteer Karen Johnson and Journey Jones make sure the kids have enough water before the next activity.



Parent chaperones Franklin Jones and Victoria Veckey standing in the foreground as the students first arrive at the Monument.